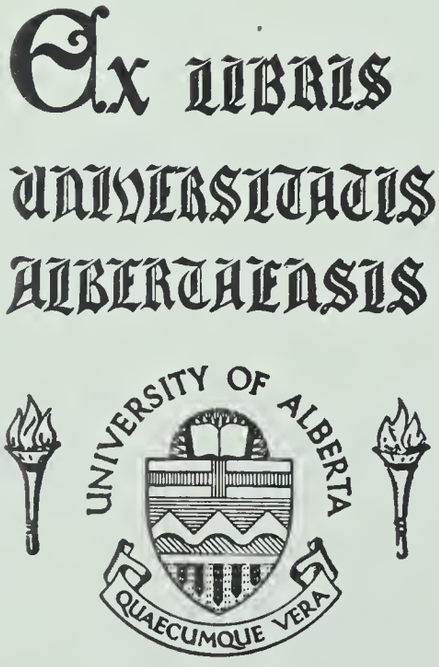


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# ANXIETY, AGGRESSION, AND KNOWLEDGE OF RESULTS IN PROGRAMMED INSTRUCTION

by

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A THESIS

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies for acceptance, a thesis entitled Anxiety, Aggression, and Knowledge of Results in Programmed Instruction, submitted by S. G. Souch in partial fulfillment of the requirements for the degree of Master of Education.

ABSTRACT

This study investigated the possible relationship between certain personality variables in learners and their achievement in programmed instruction via two different schedules of knowledge of results. Programmed instruction was assumed to represent a well structured teaching situation.

Fifth-grade public school students were administered an anxiety scale, an aggression index, and pretests of material based upon the content of two programmed science units, Sound and Light. The subjects, 53 females and 42 males, were randomly assigned to one of two schedules of knowledge of results. The schedules employed were either partial or continuous in form. Pupil performance was analyzed, for both of the experimental programmed science units, using as criterion measures: (a) an immediate post-test, and (b) a retention post-test administered 14 days after the last student completed the programmed material.

Statistical analysis of the data by the method of applied multiple linear regression analysis revealed no difference in performance between high and low-anxious subjects. However, an interaction was obtained between anxiety and knowledge of results. The findings indicated that high-anxious students performed better under a condition of continuous feedback. Significant differences were obtained between high and low-aggressive subjects on the Light program post-tests. It appears that aggressive students are impeded in learning under a relatively well structured teaching situation such as programmed instruction. The findings also suggested that pupils at the upper elementary school level probably learn best under a condition of continuous reinforcement in terms of knowledge

of results. Finally, an interactional relationship was obtained between anxiety and aggression. The analysis indicated that the high-aggressive, high-anxious students performed significantly better than low-aggressive, high-anxious students on one of the criterion tests of the Light program. Aggressiveness appeared to have no effect upon the low-anxious subjects in relation to their achievement in programmed instruction.

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# CHAPTER I

## THE PROBLEM

Programmed instruction, a recent innovation in the media of instructional techniques, has attracted the attention of educators and laymen alike. In the past decade, both industry and education on this continent have applauded the results of the 'young upstart'. Evidence from numerous sources has accumulated attesting to the marked increase in efficiency, economy, and ease of administration of the new technology.

By far the largest number of experimental studies in programmed learning have taken place in the past five years. The research reported thus far has disclosed that nearly half of these studies have dealt with presentation variables and approximately, a third with response modes. Most of the remaining studies concerned themselves with a comparison of programmed instruction and "conventional instruction", and special applications of programs, for example, programs designed for exceptional children and industrial trainees, and programmed instruction within the various subject fields.

One noticeable lack seems evident in the mounting number of studies in this field; investigators have failed to utilize, to any extent, the controlled properties of programmed instruction to study the learner variables and the effect that such variables have upon programs in relationship to achievement. Biggs, (1962, p. 11), reported that "it has become almost a fashion in cognition studies to examine the effects of non-cognitive factors upon performance in the experimental tasks." Doty and Doty, (1964, p. 334), in one of the relatively few

studies which takes into account personality variables have reported that:

> Effects of such individual differences on learning and performance in other contexts, for example, the conventional classroom, have received considerable attention in the research literature. However, no research known to the writers has been published regarding similar aspects of programmed instruction.

The purpose of this study is to investigate the influence of aggression and anxiety on the effectiveness of learning under a relatively well structured learning situation, namely programmed instruction involving two variations in schedules of knowledge of results.

No previous attempt has been made to study the possible effect of aggression upon achievement in programmed instruction. Furthermore, it appears that only two studies have investigated the influence of anxiety upon learning via the new technology. This, the present study purposes to do.

A secondary objective of this investigation is to ascertain the relationship between schedules of knowledge of results and achievement in programmed instruction. In addition, the interactional effects between the degree of anxiety or aggression, as measured by the scales used in this study, and schedules of knowledge of results will be analyzed.

Finally, other measures generally considered to have some effect upon achievement, such as: general mental ability, chronological age, socio-economic status, and previous learning will be obtained in order to determine their influence upon the criterion scores.

Chapter Two presents a review of the literature pertinent to the problem under investigation. The material reviewed will be grouped

according to three general sections.

Chapter Three provides the theoretical framework upon which this study is based. In this chapter a set of postulates are advanced from which a number of testable hypotheses are derived. Method and experimental design are dealt with in Chapter Four, while Chapter Five concerns itself with a discussion of the results of the investigation.

The final chapter entails a discussion of research findings in terms of both educational practice and theory. Mention is also made of areas for future research and the implications of such research to educators.

# CHAPTER II

## RELATED LITERATURE

The first section of this chapter concerns itself with programmed instruction. The major aspects surveyed are information related to definition; present status of programmed instruction as an instructional tool; definition of terms essential to the understanding of programmed instruction. This is followed by a review of the research on schedules of reinforcement; reinforcement theory and mode of response. The second and third sections consider anxiety and aggression. The research relevant to these variables is reported in terms of stated definitions, theoretical considerations, and the relationship of the personality constructs of anxiety and aggression to intellectual performance.

### Programmed Instruction

#### Definition

H. J. A. Goodman (1962, p. 226) advanced one definition of programmed instruction (considered here to be synonymous with programmed learning and automated instruction) in which he described it as ". . .a strategy for presenting information to an individual and developing his understanding step by step. It is a very special strategy, however, because it maintains the best conditions for learning." Wilbur Schramm, (1962, p. 1) conceived of programmed instruction as "the kind of learning experience in which a 'program' takes the place of a tutor for the student, and leads him through a set of

specified behaviors designed and sequenced to make it more probable that he will behave in a given desired way in the future. . . ." Thus, many authorities consider a sufficiently well revised program to be equivalent in many respects to a skillful tutor. Socrates, one of the oldest and most celebrated teachers of all time, demonstrated the importance of a logical continuous interaction between teacher and pupil. Inherent in the 'Socratic method', as best exemplified in Plato's Meno, is dialogue. Every question posed by Socrates was intended to lead the slave boy step by step in a logical, coherent sequence. The slave, we are reminded, was active in the process of discovering.

Many reviewers (Schramm, 1964; Cohen, 1962; Stolurow, 1962) have remarked about the similarity between the teaching methods of Socrates and the principles of programmed learning. Programmed instruction is said to mark a renaissance in the method of dialectic teaching so brilliantly mastered by Socrates over 2,000 years ago. Stolurow (1962, p. 196) has referred to the Socratic method, developed in Plato's dialogues, as the "unexcelled example of effective and skillful instructional programming," while Cohen adapted a passage from Plato's Meno into a typical form of programmed frames in an attempt to elucidate the similarities (and differences) between the Socratic and contemporary programmed learning techniques. Cohen concluded that "Socrates had the beginnings of an effective program."

As is evident from the previous discussion, advocates of programmed instruction maintain that this is not a new method of teaching (Cohen, 1962; Stolurow, 1962; Fusco, 1962). The newness, according to Fusco (1962), is the development of a technology based on a method

employed by the great teachers of the past. It is possible, then, that automated instruction when properly used as a teacher-tool or adjunct, will enable many students to receive simultaneously, individual self-instruction along the Socratic 'question and answer' vein.

In addition, programmed instruction appears not to be out of step with the principles advanced by John Dewey's 'progressivism'. D. H. Parker (1964, p. 1) a leading educational psychologist turned philosopher states:

> . . .it is desirable to provide a schooling situation in which each child may start where he is and move as fast and far as his learning rate and capacity will let him.

Such a "Multilevel Philosophy" is not antagonistic to programmed learning. Most learning programs utilize the principles of reinforcement theory (Skinner, 1962) and the learning is active precisely because the learner receives some form of feedback indicating the degree of the correctness of his response. Elley (1963, p. 12) reminds us that "numerous studies have shown the superiority of active recitation and continual self-testing over the more passive process of rereading a verbal list or passage. . .(and). . .that Skinner (too) insists on active learners." Hence, when one thinks of programmed instruction he must conceive of a learning process which entails participation by the learner. This, of course, is not a revolutionary concept in educational circles; one of the major advocates of student activity in the classroom on this continent has been the educational philosopher, John Dewey. All programmed materials do take into account the factor of individual differences in the sense that they allow each participant to proceed at his or her own pace.

Essentially then, it is the program that teaches. Such a program usually consists of a series of items of information constructed in logical progression which elicit a concomitant series of responses, either covertly or overtly. By responding in such a manner the student demonstrates the mastery of knowledge previously acquired through interaction with the program; the learner supplies answers to cued or prompted questions and the information gained is then overlearned in further use.

Definition of Terms

Linear program. A linear program is most closely associated with the theory and techniques of B. F. Skinner. The term refers to a program where the sequence of the items is fixed and all subjects proceed through the same number of frames.

Branched program. This type of program, originally conceived by Norman Crowder, makes a greater adaptation to individual differences than the linear program. In the Crowder program, the kind of response which a learner makes determines the sequence through which he will proceed. The student, whose response to a set of questions is incorrect, will be "re-routed" to sets of items containing information designed to correct his erroneous thinking. The brighter student may proceed as rapidly as he demonstrates the acquisition of material gained through using the program.

Adjunct program. An adjunct program consists of textual material followed by a quiz. Such a program usually follows the presentation of what is to be learned and serves to clarify and emphasize crucial con-

cepts. Pressey (1964) is an advocate of adjunct programming and is convinced that the test items of the program should be of the multiple choice question variety.

Covert response. This type of response merely requires the learner to think about an answer.

Overt response. An overt response involves a physical manifestation on the part of the learner as a result of stimuli presented in the form of a question, for example, writing an answer or verbalizing.

Prompting or cueing. A cue or a prompt, essentially synonymous terms, refer to a deliberate and purposeful part of the program presentation in which information is presented in a manner that greatly increases the probability of the learner making the correct response.

Error rate. Refers to the number or percentage of a given group of subjects incorrectly responding to a specific item on a program.

Frame. A frame is the smallest single unit of a program. It constitutes a coherent set of stimuli capable of eliciting a response from the program user.

## Reinforcement Theory

Central to the theoretical rationale underlying linear programmed instruction is the role of reinforcement. Certainly the 'question-answer-knowledge of results' cycle found in most programs, operates on the assumption that reinforcement is essential for learning to take place. Indeed, for Skinner, learning is reinforcement. To him the most

serious criticism of current classroom practices is "the relative infrequency of reinforcement." (Skinner, 1962, p. 25).

Lumsdaine (1964) expressed his dissatisfaction with the Skinnerian notion of 'shaping up' behavior by the manipulation of reinforcement contingencies. Instead, he believed that what programmers actually do is much closer to the "Ruleg system" of Evans, Glaser, and Homme (1960). The appropriate model according to Lumsdaine appears:

> . . .to be that of classical conditioning through simple temporal contiguity of cue and response (with a deliberate effort being made to get the desired response to occur in the stimulus-context, which will become a proper signal for its subsequent elicitation) rather than one of operant conditioning situations in which attention is focused on the reinforcing effect of a reward that comes after the response has been made. (p. 81).

Investigators other than Lumsdaine have challenged Skinner's assumption that immediate feedback in terms of knowledge of the correctness of a response is always essential to effective learning. For example, Moore and Smith (1961, 1962) contend that knowledge of results (KR) may be provided in a variety of fashions. For example, KR may be provided by (a) the medium of some signal which alerts a subject to the fact that a correct response has or has not been emitted (a green light or buzzer for a correct response), (b) immediate reinforcement for a correct response in an extrinsic manner (tokens, tid-bits, or praise), and (c) KR provided by a small-step, highly cued program. In a highly cued linear program a series of successive approximations assures a low error rate thereby leaving the provision of a correct response as having only a secondary assuring function. In partial support of this latter interpretation Evans (1960) found no significant difference in criterion

performance between immediate and slightly delayed feedback. Similarly, Hough and Revsin (1963) attributed the 'no difference' findings in regard to the effect of continuous reinforcement (100%) versus no reinforcement (0%) to a low error rate in which it was assumed that the students anticipated the correct answers, thus covertly or intrinsically reinforcing themselves.

Schedules of Reinforcement

Two general schedules of reinforcement may be said to exist, continuous reinforcement and partial reinforcement. Continuous reinforcement schedules require that every correct response be reinforced, a feature rarely encountered in everyday living. Partial or intermittent reinforcement is the procedure of presenting the reinforcing stimulus on some fraction of the trials rather than on every trial. This kind of reinforcement is more commonplace in the area of human behavior.

Staats and Staats (1963) are in general concurrence with most textbooks of psychology that four main schedules of reinforcement exist: fixed-ratio; fixed-interval; variable-ratio; and variable-interval. It is readily evident that the fixed-ratio and variable-ratio schedules which concern themselves with the number of responses between reinforcements are the schedules of importance to programmed instruction. "Since in programmed instruction each student learns at his own rate . . .temporally based reinforcement schedules are not generally applicable." (Muir, 1965, p. 18).

In their summation of a most thorough review of the literature on partial reinforcement, Jenkins and Stanley (1950, p. 231) stated:

> The most striking effects of partial reinforcement are apparent in response strength as measured by resistance to extinction. In almost every experiment, large and significant differences in extinction favoring the groups partially reinforced over the 100% ones were found. The practical implication of this principal for maintaining behavior is obvious: Administer the reinforcing stimulus in conditioning according to a partial schedule, and the behavior will be maintained for long periods in the absence of external support from primary reward.

Lewis (1960) in his selective review of the literature since 1950 found no research to contradict the generalized law of partial reinforcement as previously stated by Jenkins and Stanley.

The relation between the percentage of reinforcement of a response during acquisition of learning and the resistance to extinction of the response has been the subject of many experiments. In the above mentioned reviews by Jenkins and Stanley (1950) and Lewis (1960), the research reported deals only with discrete simple learning trials and involves mostly animal subjects.

Studies with human subjects such as those conducted by Carment and Miles (1962) and Lewis and Duncan (1962), using up to five different percentages of reinforcement, found that the greater the percentage of reinforcement and the larger the number of acquisition trials during learning, the fewer the number of responses to extinction.

The Carment and Miles (1962) study employed a lever-pulling response in humans wherein 12 1/2 per cent, 25 per cent, and 50 per cent reinforcement during acquisition was factorially combined with 8, 16, and 64 acquisition trials. Lewis and Duncan (1962) as referred to above, investigated resistance to extinction in a situation involving some risk-taking measured according to the percentage of reinforcement

and amount of reward. Each of 300 subjects was provided with a limited stake of discs with which to play an electrical slot machine. Two amounts of reward were combined in factorial design with five percentages of reinforcement (0%, 11%, 33%, 67%, or 100%).

Relatively few studies have investigated the effects of partial reinforcement on achievement in programmed instruction. Literature pertaining to these studies will be reviewed in the following section.

Krumboltz and Weisman (1962a) tested the effect of intermittent confirmation of 121 college students by omitting various patterns of confirming answers from a programmed text on educational measurement. The schedules included four levels of fixed-ratio confirmation and two of variable-ratio confirmation. Results based on criterion measures consisting of errors made on the program and performance on a post-test indicated a negative linear relationship between the number of errors made on the program and the percentages of confirmation provided. Glaser and Taber (1961) experimented with different schedules of reinforcement in a linear program. The schedules of reinforcement consisted of 100% or continuous, 50% fixed-ratio, 50% variable-ratio, and 25% variable-ratio. The criterion test revealed no learning difference attributable to any schedule of reinforcement. Glaser and Taber (1961) suggest that reinforcement by KR may be a crucial factor only when the probability of correct response is low.

Muir (1965) using a grade five science programmed textbook found

those students who learned under a condition of partial knowledge of results did not retain any more of the programmed content, as measured by a retention achievement test, than did those students who learned under a condition of continuous knowledge of results. Contrary to the experimental work of Brackbill and Kappy (1962) and Festinger (1961), to whose work he referred, Muir (1965) found that subjects under the continuous schedule achieved at a significantly higher level, using a program on Sound but not for Light.

The review of Jenkins and Stanley (1950) and Lewis (1960) leave no doubt that a schedule of partial reinforcement leads to a better retention of learning than that possible under continuous reinforcement. However, the above mentioned studies dealt mainly with simple, discrete learning using animals as subjects. That these findings can be generalized to humans learning meaningful verbal material is questionable. Using programmed instruction, Hough and Revsin (1963), Krumboltz and Weisman (1962a), and Glaser and Taber (1961), among others, found a 'no difference' situation resulting from both continuous and partial schedules of reinforcement. Krumboltz and Weisman (1962a) suggest that a retention post-test may have shown a difference in favor of intermittent reinforcement.

Mode of Response

As mentioned previously, investigators have spent considerable time in studying response variations in programmed instruction. The question subjected to most scrutiny was whether students would benefit

to the greatest extent by some overt manifestation in response to a frame, or, by merely thinking (covertly) through an answer. By far the greatest number of studies, Lambert et al (1962) Keislar and McNeil (1962) and Stolurow and Walker (1962), found no significant differences in learning between overt and covert responding.

The study by Lambert et al (1962), using 552 ninth-grade students as subjects, found intelligence to be significantly associated with the amount of information acquired from the program, yet both overt and covert response modes resulted in a similar amount of learning. The program employed was of a linear format consisting of 864 frames on sets, relations, and functions.

Keislar and McNeil (1962) compared two groups of a total of 198 elementary-school children on a programmed unit in physical science. No significant difference was found between the two groups on post-test achievement as to response mode based on the 432 frame physical science unit.

Stolurow and Walker (1962) presented a program on descriptive statistics to college students. No significant differences on the criterion measures were found between the overt and covert responding groups. However, the covert responding group took significantly less time to complete the program.

Goldbeck and Campbell (1962) reported the findings of two experiments investigating response modes. In the first experiment, grade seven subjects were assigned to either an overt, covert, or reading response mode and to one of three levels of difficulty as determined by the amount of internal cueing in each frame. Overt responding was found

to be superior to both covert responding and reading only at the intermediate level of difficulty. Efficiency scores ranked the response modes in the order of reading, covert, and overt conditions respectively. The second experiment was similar to the first except that an optional mode was included wherein the subject could "write in" his response if he was certain of its correctness. In addition, the programmed content of the second experiment differed in that it consisted of 32 frames on the topic of light, whereas the content of the first experiment contained 35 discrete items of information. The order of response mode superiority remained the same, as measured on a 10-week retention test, with reading being slightly more efficient, in terms of learning per time spent, than the covert mode.

Krumboltz and Weisman (1962b) using a linear program designed to teach college under-graduates fundamentals of educational testing, assessed the effects of variation in response modes. They found no significant difference between overt and covert responding groups on an immediate post-test yet on a two-week retention post-test the overt group retained more of what they had learned.

Sidowski et al (1961) studied the effects of overt and covert response modes on six groups of twenty college students. The program consisted of fifteen Russian-English paired vocabulary items. On an efficiency measure which took into consideration both time and learning, it was found that covert responders scored higher than overt responders.

The review of the literature indicated that where a difference occurs in learning between various response modes, the difference is generally in favor of the covert response mode. Also, the covert

response mode has shown to be more efficient since in most cases it results in as least as much learning as the overt response condition and takes less time. The covert response mode, then, appears to be the most desirable condition for use in an experimental setting.

Too few studies investigating the effects of variation in response modes upon learning via programmed instruction have included retention post-tests. Perhaps, investigators should concern themselves not only with the acquisition of knowledge but with the retention of learning over time. That differences can occur between immediate post-tests and retention post-tests is evidenced by the Krumboltz and Weisman (1962b) study previously cited. There is also the possibility that the additional practice involved in overt responding may contribute to the retention of some subject matter.

## Anxiety

Researchers as well as laymen agree that this is the age of anxiety. Freud, the father of psychoanalysis, made anxiety the central problem of neurosis. His successors, however, have made it the central problem in psychology. Cattell and Scheier (1958) doubt the validity of the claim made by many authorities that our understanding of anxiety has increased in proportion to the collosal research effort expended. These latter experts suggest that if anything has increased in proportion to research effort, it is the number of competing tests, concepts, and theories of anxiety.

### Definition

Anxiety is generally considered to be a phenomenon that manifests

itself in immediate experience as an unpleasant emotional feeling with a characteristic anticipatory character--the expectation of impending danger (Freud, 1949; Berg, 1951, 1952; Maier, 1949). Goldstein (1939, p. 36) defined anxiety as a "disordered or catastrophic" condition. Elsewhere (Ibid., p. 295) he described anxiety as "the occurrence of disordered stimulus evaluation as it is conditioned through the conflict of the organism with a certain environment which is not adequate for it." Rollo May (1950) reminds us that Freud, Kierkegaard, and Goldstein all believed anxiety to be distinguished from fear in that fear has some specific object, whereas anxiety is a vague and unspecific apprehension.

Freud (1949) believed that anxiety can exert an influence on personality even though not immediately experienced. He referred to this generalized state of apprehensiveness as "free-floating" anxiety. Descriptively, anxiety in the Freudian sense (1949, p. 70) is defined by the presence of three criteria: a state of unpleasantness, physiological concomitants, and a perception of these attributes. Others following Freud have attributed "drive" characteristics to anxiety since the organism presumably strives to avoid such unpleasantness. "It is assumed that, owing to previous experience, this unpleasant state has come to mean "danger"." (Sarason et al, 1960, p. 33).

Anxiety, for the purpose of this investigation, is operationally defined as the scores obtained on the measure employed in the present study. The anxiety scale selected for use does satisfy the criteria established by Freud and hence, is in general agreement with his theoretical orientation.

In the following pages a review of findings in the research

literature will be reported that relate specifically to the relationship between anxiety and intellectual performance. No attempt will be made to categorize or evaluate studies on the basis of the instruments employed to measure anxiety. The construct in question has been shown to be multi-dimensional rather than specific, (Jackson and Bloomberg, 1958) yet a significant relationship has been found to exist between a number of test anxiety and general anxiety scales (Sarason, et al, 1960).

The Effects of Anxiety Upon Intellectual Performance

Numerous studies have investigated the relationship between anxiety and intelligence as measured by various intelligence tests, (Kerrick, 1956; Castaneda et al, 1956a; McCandless and Castaneda, 1956; Trent, 1957; Sarason et al, 1960; and others).

Many studies report no relationship between their measure of anxiety and intelligence (McCandless and Castaneda, 1956; Castaneda et al, 1956a; and Trent, 1957). However, most studies report results which suggest that anxiety interferes with intelligence test performance (Sontag et al, 1955; Granick, 1955; Kent and Davis, 1957, and others). Zweibelson (1956), using a test anxiety questionnaire with twelve grade five classes as subjects, reported that "low" test-anxious individuals made higher MA indices than the "high" test-anxious regardless of the test instrument. One study, (Amen and Renison, 1954), reported a positive correlation between Stanford-Binet IQ's and the anxiety scores of the children in their sample. Little can be generalized from the results since the sample is exceedingly small (twelve subjects) and as Sarason et al (1960, p. 69) have since pointed out ". . .the scores obtained

on their "Anxiety" pictures test may be simply another reflection of intelligence rather than a valid measure of anxiety."

Several studies have dealt primarily with the relationship between anxiety and learning processes aside from specific intelligence test performances.

Runkel (1959) analyzed considerable research involving the effects of anxiety on learning. He discovered that performance in schoolwork is occasionally improved under low anxiety, but that high anxiety levels are uniformly found to bring about a decrement in performance. O'Brien (1957) similarly found that students who rated themselves as having the same level of tension in a relaxed situation as in a threatening situation scored lower on chronic anxiety and higher on problem solving than students who reported a change in tension between the two situations.

Analysis of the data gathered by Smock (1957) indicated that tasks composed of stimuli having anxiety arousing properties were less frequently recalled than tasks involving neutral stimulus materials. Chansky (1958) made the suggestion that when immediate recall under threat is controlled anxious subjects tend to retain less than people designated as non-anxious.

Castaneda et al (1956b) report a significant interaction between anxiety and task difficulty using 21 high and 16 low-anxious fifth grade subjects. While the high-anxious children performed at a lower level on the more difficult tasks there was no difference between the groups on the easy items. In a similar study the same authors (Palermo et al, 1956) found that on performance in a trial-and-error learning situation

the high-anxious group made more errors than the low-anxious group.

The chief criticism of the latter two studies is the failure of the investigators to control for intelligence. It is possible that the high-anxious subjects were less intelligent than their low-anxious counterparts. However, Kerrick (1956), using intelligence quotient scores as a covariate, investigated the influence of manifest anxiety and IQ on discrimination. One of the findings was that the effect of anxiety on the more intelligent group made them less discriminating, whereas the reverse was true for the low IQ group.

Several studies have reported a negative relationship between anxiety and achievement in the classroom situation (Sarason et al, 1958a, 1960; Keys and Whiteside, 1930; McCandless and Castaneda, 1956). McCandless and Castaneda (1956) calculated correlations between several anxiety scores and a number of achievement areas. For a sixth grade population it was found that the anxiety score contributed to prediction of scholastic achievement beyond that contributed by the intelligence score alone.

Some general conclusions may now be stated as suggested by the review of the literature. Although the measures of anxiety used and the population sampled are varied, the largest number of studies report some sort of interference effect of high anxiety upon academic performance. It appears that increased anxiety can have a facilitating effect, but only if the problem task or learning involved is relatively simple (Castaneda et al, 1956b; Siegman, 1956; Holbrook, 1954). The research also indicates that the less structured situation works to the detriment of the high-anxious child regardless of the scale employed to measure

the construct. Sarason et al (1960) refer to the Cowen and Thompson (1951) study as indirect supportive evidence for the contention that the "test anxious child is rigid and noncreative in his problem-solving and other intellectual processes." (Sarason et al, 1960, p. 73). Further studies by Sarason et al (1958a, 1959b) indicate a relationship between anxiety and dependency. These investigators point out that strong dependency needs require the interpersonal situation to be structured in such a fashion that the high-anxious child will know exactly what is expected of him. It is in the absence of such cues that the adverse effects of anxiety become apparent.

## Aggression

In view of the lack of research in the area under investigation, aggression has been included largely on an exploratory basis. Only a few studies have been undertaken to investigate the possible influence of aggressiveness upon achievement within conventional learning circumstances. No studies have been carried out to determine the relationship between aggression and achievement in programmed learning. The present study then, must be considered more empirical than theory-derived.

### Definition

Buss (1961, p. 1) has defined aggression as "a response that delivers noxious stimuli to another organism." Dollard, et al (1939, p. 11) had previously described the concept aggression as ". . .an act whose goal response is injury to another organism (or organism surrogate)", a definition similar in kind to that advanced by Eron et al (1961a). Most investigators are in agreement that accidental injury of another is

not aggression since such acts are not goal responses.

Aggression is operationally defined here as the score obtained by a child on the aggression index used in this study.

Development of Aggression

Neither the frustration - aggression hypothesis originally advanced by Dollard et al (1939) nor the reinforcement theory of learning such as that hypothesized by Sears et al (1953) has been able to adequately account for the development of aggressive behavior in children. In reference to the latter study Eron et al (1961a, p. 291) reported ". . .it was obvious that reinforcement theory by itself (i.e. rewards and punishments) could not account for all childhood learning. . . ."

The frustration - aggression point of view contends that aggression is a natural, unlearned reaction to frustration and that individual differences in frustration responses can be attributed to a past history of conditioning. Davitz's (1952) investigation into the frustration - aggression hypothesis revealed that the response to frustration may be constructive (i.e. nonaggressive) or antisocial depending upon the present dominant response pattern in the subject's hierarchy, an interpretation that is shared by Bandura and Walters (1963). Furthermore, Jegard and Walters (1960), Mussen and Rutherford (1961), Walters and Brown (1963) and Yarrow (1948) have failed to find differences in aggression between frustrated and non-frustrated children.

The theoretical orientation presented in the Eron et al (1961a) study stemmed from learning theory and role theory. In the context of their report they claimed that:

> . . .we can consider four explanatory factors which permit predictions of intensity, frequency, and the type of aggression in school and at home; (a) the law of effect and its extensions, i.e., rewards, punishments, generalization, displacement, etc., (b) frustration, (c) relative extent of agreement between S's role expectations and those of various socializing agents, and (d) the available models of behaviour. (Ibid., p. 296).

Using a "guess who" sociometric peer rating aggression index the above mentioned investigators found that three of six variables were related to aggression (1) lack of nurturance, (2) rejection - acceptance and (3) geographic mobility of a child. On the reinforcement side of the theoretical model it was found that the fathers of high aggressive boys punished more severely than the fathers of low aggressive boys. In addition, it was found that punishment by the father can "act either as an instigator or can serve to make him an aggressive role model for his child" (Ibid., p. 311). The last finding of some importance was that socio-economic status, is inversely related to aggression.

Boys and girls are definitely subjected to different socialization processes at least as far as the variable of aggression is concerned. That boys typically score higher on all measures of aggression than girls is borne out by Sears et al (1953); Levin and Wardwell (1962) Eron et al (1961a); and Eron (1963).

Many studies have realized the importance of modeling in the development of aggression; Eron et al (1961a); Eron et al (1961b); Bandura and Walters (1959, 1963) and Bandura (1961, 1962), Levin and Sears (1956) as reported in Eron et al (1961a) have strongly stressed the importance of the father as a role model for aggressive behavior. In a study of fantasy aggression it was found that boys who were both

punished by and identified with their fathers tended to be highly aggressive in a doll play situation. Eron (1963, p. 196) in quoting a laboratory study of Bandura et al (1963), recognized the important effect of symbolic models and made the cogent remark that "the modeling variable is a crucial one."

Aggression and Achievement

While there has been some investigation of the relationship of aggression to achievement, other than programmed instruction, well documented research is lacking.

Livson and Mussen (1957) found that nursery school children who showed a high degree of persistence in a problem task and a willingness to delay rewards also expressed less aggression over a two-week observation period. Mischel (1961) found, "that preference for delayed reward was positively associated with measures of achievement aspirations, social responsibility scores, and another independent index of ego-control." (Bandura and Walters, 1963, p. 172).

There is considerable evidence also which suggests that parental modeling influences and governs achievement striving (McClelland, 1955; McClelland et al, 1953; and Sarason et al, 1960). Winterbottom's (1958) study provides further evidence for the effect of parental training on children's achievement as does the work of Crandall, Preston and Rabson (1960). Bandura and Kupers (1963) have shown that self-control in children may be aptly acquired through observational learning. In commenting on the finding of Crandall, Katkovsky, and Preston (1962), Bandura and Walters (1963, p. 175) state that "parental modeling may influence not

only the standards that govern achievement behavior but also the direction that achievement striving takes."

The available literature indicates the importance of socializing agents in the development of aggression. Furthermore, it appears that children may either demonstrate ego-control, persistence, the ability to tolerate delay of rewards, and need for achievement or an inability to persist in a problem-solving situation and other correlates of a general lack of ego-control. Lunzer (1960) found aggressive children to do less well than either withdrawn (anxious) or well-adjusted children on Vernon's Graded Arithmetic-Mathematics Test and on Raven's Progressive Matrices test. The investigator (Lunzer, 1960) attributed their poor performance to "their tendency to carelessness. . .(and their lack of) . . .desire to conform to adult authority." (p. 121).

The purpose of this chapter has been to examine the roles of anxiety and aggression in terms of a critical review of previous investigations and related literature. In addition, a survey of certain aspects of programmed instruction has been undertaken.

The review of the literature should provide an overview for a framework of theory in the area under investigation. It would then be possible to derive certain postulates which, in turn, should generate a number of testable hypotheses.

# CHAPTER III

## THEORETICAL FRAMEWORK

### Anxiety

The psychoanalytic concept of anxiety as advanced by Freud (1936, 1949; Madison, 1961) exists today as the prototype for all later theoretical contributions to the understanding of anxiety (May, 1950; Sarason et al, 1960).

Freudian theory contends that the first anxiety reaction occurs at birth and is an uncontrollable, helpless, physiological reaction state that completely overwhelms the individual. After birth the helpless neonate is said to experience new painful stimuli which Freud regarded as constituting a dangerous state (Madison, 1961, p. 112). Gradually, anxiety comes to take the form of a signaling function since it now occurs in a modified fashion before the onset of the painful stimulation. In one of his earlier writings Freud (1936) comments upon the transition of anxiety in the developing human organism from an automatic reaction to danger to an ego-controlled signaling function.

> A danger situation is a recognized, remembered, expected situation of helplessness. Anxiety is the original reaction to helplessness in the trauma and is reproduced later on in the danger-situation as a signal for help. The ego which experiences the trauma passively, now repeats it actively in a weakened version, in the hope of being able to direct its course. (Ibid., pp. 166-167).

Freud concluded that each period of an individual's life has its appropriate determinant of anxiety and that learned reactions to anxiety are basic determinants of personality differences in later life.

Both Freud's (1936, 1949; Madison, 1961) and Mowrer's (1956,

1960), position with regard to the theoretical aspect of anxiety have been incorporated into the work of Berlyne (1960) by Anderson (1961). In commenting upon the similarity of the two systems Anderson states that:

> Borrowing extensively from Freud's concept of 'signal anxiety', Mowrer suggests that ". . .expectation and anxiety lie along a continuum with the former merging into the latter at the point at which it becomes uncomfortably intense, i.e. begins to take on motivational properties in its own right. . . ." In other words, anxiety is associated with significantly high arousal, or with the expectancy of that arousal. The deep and intense expectation termed 'signal anxiety' motivates the individual to respond suitably to cues premonitory of the noxious stimulus (Ibid., p. 150).

Sarason et al (1960) remind us that Sullivan (1953, 1956) has performed an important theoretical service by differentiating between anxiety and fear in terms of their differing roles in relation to the self-system. The self-system is the product of interpersonal experience; it is "an organization of educative experience called into being by the necessity to avoid or to minimize incidents of anxiety." (Perry and Gawel, 1953, p. 165). Sullivan regards anxiety as warning of internal discrepencies in the self-system, while fear is regarded as a synamism for handling external danger.

Perhaps Sullivan's most important contribution to our understanding of anxiety is his emphasis on the role of 'significant others' in its development. The child is said to learn by "the grading of anxiety" which follows from Sullivan's definition of anxiety as the need for approval of significant others. Indeed, for Sullivan, "anxiety is always related to interpersonal relations." (Mullahy, 1959, p. 170).

The role of interpersonal factors in the development and later manifestations of anxiety is explicit in the research discussions of Sarason et al (1960). These investigators, relying heavily upon the

theoretical framework of Freud and Sullivan, conclude ". . .it is axiomatic that anxiety in children cannot be understood without attention to their relationship with parents and parent-surrogates." (Ibid., p. 38). Furthermore, the theoretical considerations of Freud (1936, 1949) and Sullivan (1953, 1956) suggest that anxious reactions are the outgrowth of a situation in which the child's behavior has come to be controlled through the threat of loss of parental approval or love.

It is conceivable that the anxious reaction in relation to school reflects a transference to the teacher of the anxiety that was fostered in the parent-child relationship. The teacher, through the process of generalization, could come to represent to the child, many of the attributes associated with the parental models.

Furthermore, the classroom presents a situation in which the child experiences continual evaluation by adults. Unfortunately, since the conceptualization of some threat to the "self-system" sets off an anxious reaction, (Sullivan, 1953, 1956) the anxious child is ever alert to cues to approval-disapproval by significant others. That the anxious child's preoccupation with unpleasant anxiety arousing cues interferes with his problem-solving and learning efficiency is well documented by research. A review of the literature has revealed that the highly anxious individual is at a marked disadvantage when placed in a new learning situation (Sarason et al, 1958b; Runkel, 1959; O'Brien, 1957; Siegman, 1956; Taylor and Spence, 1952; Chansky, 1958; Smock, 1957).

The discussion thus far has served to point out that under ordinary classroom learning circumstances, the more anxious individual will not achieve as well as his less anxious counterpart. In addition

the high-anxious child is eager to please others (Sullivan, 1953, 1956), tends to be dependent, and is rigid in terms of his problem solving approach (Sarason et al, 1960). However, there is some theoretical and experimental evidence to suggest that the high-anxious child may function at a level expected of a less anxious child when he knows exactly what is expected of him (i.e. what is right or wrong). For example, Sarason et al (1958a, 1958b, 1960) and Smith et al (1956). Similarly, Biggs (1962) in examining a review of the effects of anxiety upon performance by Hanfmann (1950) reiterates this apparent importance of a well structured stimulus situation. Biggs (1962) reports that:

> The common feature amongst theories of anxiety. . .is that they emphasise vagueness of cognitive structure where the stimulus is clear, highly anxious people may function excellently, but in a vaguely defined situation, anxious people manifest poorly organised performance. (Ibid., 1962, p. 59).

Moreover, it appears that instructional methods do make a difference for certain kinds of pupils. For example, Grimes and Allinsmith (1961) tested the hypothesis that there would be an interaction between teaching methods and certain personality characteristics of students in the determination of achievement of elementary school children. Two of their findings are of considerable importance here: (1) Anxious children do as well as non-anxious children under structured conditions, and (2) Anxious children have their achievement impeded in unstructured settings. Programmed instruction represents one such highly structured learning situation.

Traweek (1964) studied the relationship between various personality variables in learners and their achievement on programmed

instruction involving fourth grade arithmetic fractions. With effectiveness being determined by a comparison between actual and predicted achievement, it was found that subjects whose test reports indicated poorer adjustment, (in terms of being anxious, withdrawn, less self-reliant) achieved beyond their expected performance. Kight and Sassenrath (1966) reported a 'no difference' finding between high and low test-anxious college students when learning via programmed instruction.

It appears then that programmed instruction suits the needs of high-anxious children. A well written program guides its users logically from one unit of information to another. Repetition, employing well spaced cues, assures learning with a minimum of errors. Feedback, in terms of knowledge of the correctness of a response, whether presented continuously or by means of some variable schedule should serve to reinforce the adequacy of the high-anxious student's performance.

Mention was made of Berlyne's theoretical position (Anderson, 1961) in which high arousal was considered to be a correlate of anxiety. The point of view advanced in this paper is in agreement with the above statement but goes further to posit that the individual in a state of high drive also experiences those characteristics Freud (1949) referred to as constituting anxiety. It is of relevance here to note that the Iowa investigators (Palermo et al, 1956) consider the score on their anxiety scale to be a measure of drive.

Perhaps the most crucial aspect from the theoretical point of view is that a cue functions to inform the individual of some impending

danger. A problem task or stimuli in the form of a question, when presented within the context of the classroom, would act as a signal for some anxious expectation according to the past experiences of the child.

Although Woolman (1964) admits that programmed learning reduces social interaction in the classroom, Sullivan's (1953, 1956) theory would suggest that the now controlled interpersonal situation would no longer pose a threat to the child's self-system. From this theoretical position, it would also follow that the evaluative aspect of the teacher-pupil relationship would be greatly reduced when learning takes place under programmed instruction.

It is in the context of anxiety then, that one comes to recognize the value of programmed instruction. According to Berlyne (1960), an optimum arousal level is necessary in order to promote maximum learning efficiency. A well written program would constitute a series or pattern of arousal increases followed by arousal decreases to an optimum level. The general theoretical framework of this study is similar to that advanced by Anderson (1961):

> ". . .that learning is impossible without this primary state of arousal-imbalance which mainly takes the form of a significant arousal increase. . .but which might hypothetically also take the form of significant arousal-decrease below optimum level. . . ." (Ibid., p. 151).

It seems logical then to expect both high-anxious and low-anxious students to perform at the same level using programmed instruction since all students should attack each problem (i.e. frame) in anticipation of the 'payoff' value (arousal reduction). This aspect of Berlyne's model is not antagonistic to that advanced by Pribram (1964).

Pribram suggests that reinforcement (or knowledge of results) is the expression of an individual's tendency toward orderliness and that the central nervous system is so constructed that order or structure is imposed on stimulus inputs. Thus, it is this structure of readiness or expectancy that is reinforcing and we are forced to recognize that in both Berlyne's and Pribram's systems, learning by either variable-ratio or continuous reinforcement can be cognitively pleasurable. This leads directly to the intrinsic motivational properties of 'the program'. The error rate is so deliberately low that every student is reasonably well assured of arousal reduction in the form of a correct response with or without knowledge of results.

In conclusion, it appears that whereas high-anxious students perform less well than low-anxious students in a conventional classroom situation, such students learning by means of programmed instruction will not experience such differences.

Aggression

Although, as has been mentioned previously, the relationship of achievement to the concept aggression has not been adequately researched, there is some indication that the more impulsive, aggressive child demonstrates the inability to delay rewards sufficiently until a confronting problem situation has been mastered. The work of Livson and Mussen (1957), Mischel (1961), and Bandura and Walters (1963) points in this direction.

It is possible also that the aggressive child resents being forced to comply with adult demands (Lunzer, 1960). Being more impulsive

and tending to be less conforming than his less aggressive counterpart, the aggressive child would likely not achieve as well under a highly structured situation. A less well defined, more laissez-faire type of learning condition would impose less order or control to the aggressive child's actions.

Schedules of Knowledge of Results

As mentioned in the review of the literature, studies involving different schedules of reinforcement and the effect of such schedules upon achievement in programmed instruction have been relatively scarce. The majority of the studies dealt chiefly with simple, discrete learning involving both animal and human subjects. Investigators such as Jenkins and Stanley (1950) and Lewis (1960) reported many findings illustrating the effectiveness of partial reinforcement in building a resistance to extinction in animal learning. However, some doubt has been raised as to the validity in generalizing the above mentioned findings to humans learning meaningful verbal material in a programmed sequence (see page 13).

Those studies investigating the effects of different schedules of knowledge of results upon achievement in programmed instruction have generally reported a 'no difference' finding (Hough and Revsin, 1963; Krumboltz and Weisman, 1962b; Glaser and Taber, 1961). It was suggested that reinforcement by KR may be important only when the probability of error is high.

One of the chief purposes of this study has been to investigate the possible relationship between anxiety and aggression in learners and

their achievement under a specified method of instruction, namely programmed instruction. In so doing there has been an attempt to link together the findings of various studies under one general theoretical framework; it is from this basis that a set of postulates may now be advanced.

Postulate I

Achievement is positively related to the structure of the teaching situation for high-anxious students but not for low-anxious.

Postulate II

Achievement of highly aggressive students is inversely related to the structure of the teaching situation.

Postulate III

When knowledge of results is provided in a small-step, highly cued program with a low error rate, the schedules of reinforcement employed have no effect upon the achievement of the learners.

Interaction Between Aggression and Schedules of Knowledge of Results

The review of the literature gives little guidance as to the interactional effects that might be obtained when aggression and schedules of KR are analyzed together. As a consequence no interaction will be predicted.

Hypotheses

It is now possible to derive a number of hypotheses from the set of postulates that have been advanced. These hypotheses will form the

basis for testing the adequacy of the theory as it is presented here. The hypotheses will be listed below according to their relationship to the postulates previously stated. It will be noted that two hypotheses are derived from Postulate I.

Postulate I

1. For those students identified as either high-anxious or low-anxious there will be no difference in achievement in programmed instruction:
   A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.
   B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.
2. There will be an interaction between the structure of the teaching situation and anxiety, with the high-anxious students achieving better as the teaching condition becomes more structured:
   A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.
   B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

Postulate II

3. Those students who are identified as being high-aggressive will achieve at a lower level in programmed instruction than those identified as low-aggressive:
   A. On an immediate post-test and retention post-test based

on a Sound programmed science unit.

B. On an immediate post-test and retention post-test based on a Light programmed science unit.

Postulate III

4. Students who have learned under the condition of partial knowledge of results (33 1/3%) will not achieve at a higher level in programmed instruction than those who have learned under a condition of continuous knowledge of results (100%).

A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.

B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

# CHAPTER IV

## METHOD AND EXPERIMENTAL DESIGN

The previous chapter focused chiefly upon the formation of a theoretical framework in which both reported research and theory were brought together in order to promote hypotheses for experimental investigation. This chapter will describe the population sampled as well as the procedures used in obtaining the data. Furthermore, some discussion will be made of the kind of programmed instruction employed and the instruments used in assessment, including criterion tests.

### The Programs

The Science Tutor, a programmed instructional booklet consisting of three complete units in Sound, Light, and Weather, was used in the study. The programs, developed by the Division of Educational Research at the University of Virginia (Charlottesville), were ideally suited for students at the upper elementary school level. The content covered in the booklet is similar in kind to that listed in the Alberta curriculum for grade six science (Daniels, 1963) while the vocabulary of the programs approximates a grade four reading level.

The programs are composed of small step, highly cued linear sequences. When the Science Tutor was used with sixty grade five students, comparable in terms of age, grade, and socioeconomic status to the subjects of this study, the mean number of errors for the sound and light units were 2.47 per cent and 2.06 per cent respectively (Muir, 1965).

Branching is provided on the basis of the subject's performance on

numerous short sub-tests following each related sub-section of the program. At various stages in the program learners were required to perform simple experiments found on a table at the back of their classroom. Upon completion of the experiments students would return to their desks and continue with the program.

Two forms of the Science Tutor were available for use. The learners either used a program providing 100 per cent continuous knowledge of results or one providing partial knowledge of results in the form of 33 1/3 per cent. The 33 1/3 per cent programs were variable ratio.

The units on Sound, Light, and Weather contained 331, 446, and 381 frames respectively.

## Presentation of the Programs

The order of presentation consisted of Sound, Light, and Weather for all subjects. The first two programs were treated as replicated experimental treatments; the third program served to accommodate the more rapid learners until the slowest learner completed the Light unit. The subjects were instructed to respond covertly by reading and 'silently' answering questions provided in the frames.

## The Subjects

The subjects used in this investigation were drawn from three grade five classrooms of Hazeldean Elementary Public School, Edmonton. This school appeared to the investigator to meet the requirements of a mid socioeconomic area. This assumption was proven valid as indicated by the Canadian Occupational Scale (Elley, 1961) which showed a mean value of 48.51. The Canadian occupational mean is taken as 50.0.

There were originally 97 subjects in the sample. Illness of two of the subjects left the investigator with incomplete data thus forcing a reduction in the sample to 95. Fifty-three of the subjects were girls and 42 boys. Table I contains descriptive information of the sample used in this study.

Procedure of the Experiment

The experiment was conducted during May and June of 1965. The learning period took approximately 35 minutes per day for eleven school days. Testing sessions required an additional four days.

The anxiety scale, the aggression index and the Sequential Test of Educational Progress, Science, Form 4A were administered in the first session. On the second day pretests on Sound and Light were administered. Subjects were then separated according to sex and with the use of a table of random numbers randomly assigned to one of the two schedules of knowledge of results (100 per cent or 33 1/3 per cent).

Upon completing each of the experimental units, each subject was provided with an appropriate immediate post-test. Fourteen days after the last subject had completed the final experimental unit, all subjects were administered delayed retention post-tests for Sound and Light. Consequently, the investigator had both immediate and delayed retention tests of the experimental units for analysis. A second administration of the anxiety scale was made following the delayed retention post-tests.

The Lorge-Thorndike Intelligence Tests Level 3, Form A, provided data with regard to a measure of verbal and non-verbal intelligence while chronological age in months, and socio-economic status were also

TABLE I

MEANS AND STANDARD DEVIATIONS OF COVARIATE AND CRITERION DATA FOR TOTAL SAMPLE (N = 95)

| | Variable | Mean | Standard Deviation |
|---|---|---|---|
| 1. | Science STEP test (form 4A) | 41.38 | 7.64 |
| 2. | Chronological age (in months) | 131.33 | 5.96 |
| 3. | Lorge-Thorndike Verbal IQ | 110.82 | 13.79 |
| 4. | Lorge-Thorndike Non-verbal IQ | 107.63 | 13.07 |
| 5. | Aggression Index | 17.27 | 25.13 |
| 6. | Anxiety Scale | 10.85 | 3.81 |
| 7. | Blishen Scale | 48.51 | 6.12 |
| 8. | Sound Pretest | 8.18 | 2.56 |
| 9. | Light Pretest | 10.50 | 3.72 |
| 10. | Sound Immediate | 12.14 | 3.68 |
| 11. | Light Immediate | 14.08 | 4.80 |
| 12. | Sound Retention | 13.27 | 4.03 |
| 13. | Light Retention | 14.50 | 5.11 |

obtained.

Elley, (1961) in an unpublished doctoral dissertation found Blishen's (1958) socio-economic index to be a useful tool for assessing socio-economic status in the Edmonton area. Blishen's Canadian Occupational Scale ranges from thirty-two to ninety with a mean of approximately fifty and a standard deviation of ten. This, was the scale selected for use in this study.

The Anxiety Scale

The measure of anxiety used in this investigation is largely the result of a factor analytic study by O'Connor et al (1956) of the Taylor scale of manifest anxiety. Tetrachoric correlations between 42 of the items considered to measure manifest anxiety were factored by the centroid method and rotated to simple structure. The factor accounting for most of the variance was subsequently identified as chronic anxiety or worry.

Fourteen of the items with the highest loading on the prime factor were selected for use as a measure of general anxiety. An additional six items from Sarason's Test Anxiety Scale (1958c) were included to assure that a high score was indicative of not only anxiety in a variety of situations but in the experimental situation as well. Fifteen 'filler' items were also included in the scale. The items were also modified to suit the comprehensibility of the population for which they were intended.

Two kinds of reliability were sought: internal consistency as measured by the Kuder-Richardson Formula 20, (Ferguson, 1959, p. 28), and test-retest reliability. The internal consistency measures were .669

on the first administration and .707 on the second administration. The test-retest reliability, with approximately a three week interval, revealed a correlation of .739.

The Aggression Index

Essentially the aggression index is a "Guess-who" device in which every pupil in a class rates every other pupil on a carefully selected series of twenty-two aggression items.

This measure of aggression as developed by Walder et al (1961) represents the efforts of a laborious process of analysis of over 1000 short behavioral descriptions as determined by a review of the literature and clinical records. The final distillation depended also upon pilot studies, including a tryout of two alternate forms on 974 elementary school pupils.

The reliability of this instrument had shown to be excellent and the author's (Walder et al, 1961) well documented justification for its use appears to be acceptable; the purpose

> . . .is to use the peers in the classroom as conveniently placed observers (e.g. Egbert, et al, 1958). Thus a major goal is to have interjudge agreement within the choice pattern. If such is obtained, the resulting object scores (judgments) may then be viewed as reliable indices of aggression, the characteristic being rated. This view in contrast to the sociometric view, hopefully regards the judges as performing like a set of homogeneous test items (see Guilford, 1954, p. 394; Siegel, 1956, p. 238). (Ibid., p. 498).

The interjudge reliability was .873 for all aggression items for boy groups and .732 for all items for girl groups (Walder et al, 1961).

The Criterion Tests

Two multiple choice criterion tests were developed for use in

this study, one for the Sound program and the other for the Light program. Bloom's (1956) taxonomy was used as a guide to test development in order to ensure an adequate sample of the educational objectives being taught by the programs.

While the pre-test and immediate post-test measures were the same, the delayed retention tests constituted longer revised editions of the immediate post-tests which had been subjected to an item analysis.

A table of descriptive statistics for all three administrations of the Light and Sound criterion tests appears in Appendix D. Samples of the delayed retention post-tests are found in Appendix E.

## Statistical Procedure

The chief statistical analysis employed was that of applied multiple linear regression as described by Bottenberg and Ward (1963). This mode of hypothesis testing is essentially that of analysis of variance and covariance. The IBM-7040 computer at the University of Alberta was used extensively in the analysis of the data.

# CHAPTER V

## RESULTS AND DISCUSSION

### Achievement In Programmed Instruction

In an effort to determine if any real learning did take place, a "t" test for correlated samples was calculated between pre-test and immediate post-test means. The results indicated in Table II show that learning did occur.

### Sex Differences

In order to assess the influence of possible sex differences, "t" tests were computed between relevant variables according to sex groupings. The findings are reported in Table III.

As can be seen in Table III, the peer-rating measure of aggression used in this study when involving ratings by both sexes revealed a marked sex bias. However, as is mentioned in the review of the literature, the fact that boys score higher on all kinds of measures of aggression has been a consistent finding (Sears et al, 1953; Levin and Wardwell, 1962; Eron et al, 1961; Eron, 1963).

Since, as Eron (1963, p. 196) suggests, it is impossible to generalize from boys to girls in research as far as the variable of aggression is concerned, it seemed desirable to eliminate such a bias by having the scores derived from peer nominations of like sexes. The assumption being that both boys and girls exhibit varying degrees of aggressiveness and the concern here is to determine the influence of aggression upon achievement in programmed instruction for learners of

TABLE II

TESTS OF "t" BETWEEN PRETEST AND IMMEDIATE POST-TEST ACHIEVEMENT (N = 95)

| | Pretest | | Immediate Post-test | | | |
|---|---|---|---|---|---|---|
| | Mean | S.D. | Mean | S.D. | r | t[a] |
| 1. Sound | 8.18 | 2.56 | 12.14 | 3.68 | .459 | 11.25* |
| 2. Light | 10.50 | 3.72 | 14.08 | 4.80 | .545 | 8.22* |

[a]one-tailed test, d.f. = 94; *$p < .01$

both sexes. Furthermore, both inspection of the data and a correlation of .773 obtained between the two administrations of the measure indicate that the relative standings of the individuals remained the same.

It is also noted that girls achieved better on the Sound pretest than did boys. There appears to be no logical explanation for this finding other than the generally well accepted fact that girls tend to achieve better than boys under conventional classroom learning circumstances at the elementary school level. This, then, may be one instance of such a difference in achievement.

Selection of Covariates

Since the model employed for statistical analysis was in essence a three-way analysis of covariance, it was deemed necessary to determine which covariate measures contributed significantly to the prediction of

TABLE III

MEANS, STANDARD DEVIATIONS, AND "t" TESTS ON SEX GROUPS

| | Variable | Females (N = 53) | | Males (N = 42) | | |
|---|---|---|---|---|---|---|
| | | Mean | S.D. | Mean | S.D. | t[a] |
| 1. | Science STEP | 40.70 | 7.85 | 42.24 | 7.28 | .970 |
| 2. | Age (in months) | 130.96 | 5.85 | 131.79 | 6.06 | .663 |
| 3. | L-T Verbal IQ | 112.43 | 14.18 | 108.79 | 12.85 | 1.284 |
| 4. | L-T Non-verbal IQ | 109.26 | 11.57 | 105.57 | 14.35 | 1.374 |
| 5. | Aggression Index (1st) | 6.79 | 7.46 | 30.50 | 32.33 | 5.114** |
| 6. | Aggression Index (2nd) | 11.96 | 12.75 | 16.76 | 16.73 | 1.570 |
| 7. | Anxiety Scale (1st) | 11.43 | 3.70 | 11.07 | 3.42 | .485 |
| 8. | Anxiety Scale (2nd) | 11.02 | 4.26 | 10.64 | 3.13 | .474 |
| 9. | SES | 48.89 | 6.54 | 38.04 | 5.52 | .668 |
| 10. | Sound Pretest | 7.70 | 2.56 | 8.79 | 2.44 | 2.079* |
| 11. | Light Pretest | 10.13 | 3.41 | 10.98 | 4.02 | 1.094 |
| 12. | Sound Immediate | 11.81 | 3.36 | 12.55 | 4.01 | .962 |
| 13. | Light Immediate | 14.34 | 4.49 | 13.76 | 5.14 | .577 |
| 14. | Sound Retention | 12.75 | 3.52 | 13.93 | 4.51 | 1.410 |
| 15. | Light Retention | 14.57 | 4.99 | 14.43 | 5.26 | .129 |

[a]two-tailed test, d.f. = 93; *$p < .05$; **$p < .0001$

the criteria. A reduction in the number of covariates in the multiple linear regression analysis results in a more refined statistical treatment since a smaller "F" value is required to achieve significance (Bottenberg and Ward, 1963).

A stepwise regression analysis (Efroymson, 1960) was used to determine which predictor variables accounted for the largest proportion of the criterion variance. The correlation matrices upon which the stepwise regression analyses were computed are shown in Tables IV and V.

The results of the stepwise regression analyses are reported in Table VI. The analyses indicate that the science STEP test, pretest scores, Lorge-Thorndike Verbal IQ scores, and age are the most pertinent predictors for the criterion tests. The inclusion of the Lorge-Thorndike Non-verbal scores were considered unnecessary since they were not as good a predictor as the Verbal IQ scores and would have contributed little to the major analyses since the correlation of the Verbal and Non-verbal scores were in the order of .71. Similarly, sex was not considered a relevant predictor. Test of "t" according to sex groupings on fifteen variables had previously failed to provide any real evidence of a consistent sex differences. Finally, socio-economic status was deleted from further analyses since it failed to achieve significance on a single criterion.

## Tests of Hypotheses

As stated previously, for the testing of the hypotheses of this study, the main statistical model employed was that of applied multiple linear regression (Bottenberg and Ward, 1963). This model permits the

TABLE IV

CORRELATION MATRIX OF VARIABLES ENTERING
STEPWISE REGRESSION ON SOUND CRITERIA

| Variable | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 1. STEP (science) | -271[a] | 654 | 524 | 109 | 100 | 418 | 703 | 588 |
| 2. Age (months) | | -480 | -427 | -038 | 069 | -160 | -194 | -061 |
| 3. Verbal IQ | | | 710 | 266 | -132 | 324 | 577 | 512 |
| 4. Non-verbal IQ | | | | 174 | -141 | 132 | 516 | 372 |
| 5. SES | | | | | -069 | 256 | 207 | 208 |
| 6. Sex | | | | | | 211 | 099 | 145 |
| 7. Pretest | | | | | | | 459 | 339 |
| 8. Immediate | | | | | | | | 722 |
| 9. Retention | | | | | | | | |

[a]All decimal points and diagonal elements have been omitted.

TABLE V

CORRELATION MATRIX OF VARIABLES ENTERING
STEPWISE REGRESSION ON LIGHT CRITERIA

| Variable | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|
| 1. STEP (science) | -271[a] | 654 | 524 | 109 | 100 | 403 | 661 | 668 |
| 2. Age (months) | | -480 | -427 | -038 | 069 | -115 | -097 | -116 |
| 3. Verbal IQ | | | 710 | 266 | -132 | 461 | 623 | 598 |
| 4. Non-verbal IQ | | | | 174 | -141 | 413 | 552 | 488 |
| 5. SES | | | | | -069 | 053 | 145 | 092 |
| 6. Sex | | | | | | 113 | -060 | -013 |
| 7. Pretest | | | | | | | 545 | 562 |
| 8. Immediate | | | | | | | | 775 |
| 9. Retention | | | | | | | | |

[a]All decimal points and diagonal elements have been omitted.

TABLE VI

STEPWISE REGRESSION ANALYSES
(N = 95)

| Variable | Criteria: Sound Immediate | | | | Sound Retention | | | | Light Immediate | | | | Light Retention | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Step | Var. | df | t | Step | Var. | df | t | Step | Var. | df | t | Step | Var. | df | t |
| 1. Science STEP | 1 | 49.47 | 93 | * | 1 | 34.52 | 93 | * | 1 | 43.66 | 93 | * | 1 | 44.62 | 93 | * |
| 2. Pretest | 2 | 3.30 | 92 | 6.43* | 6 | 0.42 | 88 | 0.37 | 2 | 9.32 | 92 | 18.23* | 2 | 10.27 | 92 | 20.94* |
| 3. L-T Verbal IQ | 3 | 0.33 | 89 | 0.70 | 2 | 2.86 | 92 | 4.21* | 3 | 2.99 | 91 | 6.17* | 3 | 1.61 | 91 | 3.38* |
| 4. Age | 4 | 0.67 | 90 | 1.40 | 3 | 3.62 | 91 | 5.58* | 4 | 3.23 | 90 | 7.13* | 4 | 1.91 | 90 | 4.14* |
| 5. L-T Non-Verbal IQ | 3 | 3.81 | 91 | 7.99* | 7 | 0.07 | 87 | 0.10 | 5 | 1.47 | 89 | 3.33* | 7 | 0.10 | 87 | 0.21 |
| 6. Sex | 6 | 0.21 | 88 | 0.45 | 4 | 1.89 | 90 | 2.97* | 6 | 0.70 | 88 | 1.60 | 5 | 0.45 | 89 | 0.98 |
| 7. Socio-economic Status | 7 | 0.20 | 87 | 0.42 | 5 | 0.73 | 89 | 1.15 | 7 | 0.00 | 87 | 0.00 | 6 | 0.13 | 88 | 0.27 |
| Total Per cent of Variance | | 58.00 | | | | 43.92 | | | | 61.37 | | | | 59.09 | | |

*Indicates significant predictor

inclusion of scores for variables which can be either continuous or categorical in form. In the present study, treatment (schedule of knowledge of results) is considered to be a categorical predictor while both anxiety and aggression are used as continuous predictors.

The Method of Applied Multiple Linear Regression Analysis

The general approach to hypothesis testing using applied multiple linear regression analysis will be illustrated below. The full or unrestricted model takes the following form:

$$Y = a_0 + a_1(X_1) + a_2(X_2) + a_3(X_3) \ldots\ldots a_n(X_n)$$

where

Y = the criterion, which varies according to the hypotheses being tested

$a_0$ = the regression constant

$a_1, a_2, a_3 \ldots\ldots a_n$ = regression weights

$X_1, X_2, X_3, \ldots\ldots X_n$ = predictor variables

To test a hypothesis, the $R^2$ associated with the full model is compared to the $R^2$ of the restricted model in which the predictor variable being tested (for example, $X_3$) is deleted. A comparison of the efficacy of prediction of model 1 (full) versus model 2 (restricted) is made by computing the ratio:

$$F = \frac{(R_1^2 - R_2^2)/df_1}{(1 - R_1^2)/df_2}$$

where

$R_1^2$ = squared multiple correlation for the full model

$R_2^2$ = squared multiple correlation for the restricted model

$df_1$ = degrees of freedom numerator; number of unknown weights in the full model minus the number of unknown weights in the restricted model.

$df_2$ = degrees of freedom denominator; number of subjects minus the number of unknown weights in the full model.

Hypothesis 1

For those students identified as either high-anxious or low-anxious there will be no difference in achievement in programmed instruction:

a. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.

B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

What must be determined in testing Hypotheses IA and IB is whether or not students tend to differ in achievement in programmed instruction on criterion tests when they have different anxiety scores. The results of the analyses are found in Table VII.

As can be seen in Table VII Hypotheses IA and IB were supported. The hypothesized 'no difference' finding was upheld on both criterion tests for the two experimental programs.

Hypothesis 2

There will be an interaction between the structure of the teaching situation and anxiety, with the high-anxious students achieving better as the teaching condition becomes more structured:

A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound

B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

The statistical model employed here attempted to determine whether the relationship of one predictor (anxiety) to the criterion tests varied

according to the level of a second predictor (knowledge of results). The hypothesis that the two predictors, anxiety and KR, interact was tested by means of applied multiple linear regression analysis. Continuous knowledge of results was assumed to provide a more structured learning condition than that afforded by 33 1/3% knowledge of results.

Inspection of Table VIII indicates that Hypothesis 2A was not supported while Hypothesis 2B was found to be in the expected direction.

Figure I graphically depicts the interaction that was obtained between anxiety and knowledge of results. It can be seen that on one criterion post-test, Light-immediate, the high-anxious subjects did slightly better under a condition of continuous knowledge of results. The low-anxious subjects performed somewhat better under a condition of partial reinforcement.

Hypothesis 3

> Those students who are identified as being high-aggressive will achieve at a lower level in programmed instruction than those identified as low-aggressive:
>
> A. On an immediate post-test and retention post-test based on a Sound programmed science unit.
>
> B. On an immediate post-test and retention post-test based on a Light programmed science unit.

The tenability of Hypotheses 3A and 3B was examined by means of applied multiple linear regression analysis. An attempt was made to determine whether the aggression index provides information useful in predicting achievement scores in programmed instruction. In this analysis, both the aggression and achievement variables are continuous in form.

The results of the analyses are reported in Table IX. Reference

TABLE VII

MULTIPLE LINEAR REGRESSION TESTS OF
HYPOTHESES 1A AND 1B
(N = 95)

| | Hypothesis | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | $R^2$ | df | F | Prob. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Immediate | | | | | | | | | | | | | |
| 1A. | Sound (Full) | .231 | .043 | .067 | .015 | -.064 | .266 | .468 | .000 | -12.465 | .565 | | | |
| | Sound (Rest.) | .230 | .049 | .069 | .015 | | .257 | .413 | .000 | -14.108 | .561 | 1/88 | .879 | .351 |
| | Retention | | | | | | | | | | | | | |
| | Sound (Full) | .199 | .137 | .094 | -.018 | -.069 | .176 | .775 | .000 | -24.236 | .432 | | | |
| | Sound (Rest.) | .199 | .145 | .096 | -.018 | | .166 | .710 | .000 | -26.132 | .428 | 1/88 | .639 | .426 |
| | Immediate | | | | | | | | | | | | | |
| 1B. | Light (Full) | .238 | .154 | .118 | -.037 | -.067 | .323 | 1.140 | .000 | -31.727 | .614 | | | |
| | Light (Rest.) | .237 | .159 | .119 | -.038 | | .320 | 1.082 | .000 | -33.366 | .611 | 1/88 | .639 | .426 |
| | Retention | | | | | | | | | | | | | |
| | Light (Full) | .287 | .118 | .080 | -.082 | -.072 | .394 | 1.484 | .000 | -24.769 | .645 | | | |
| | Light (Rest.) | .286 | .125 | .082 | -.239 | | .390 | 1.426 | .000 | -26.663 | .642 | 1/88 | .675 | .414 |

1. Science STEP test
2. Age
3. L-T Verbal IQ
4. Aggression Index
5. Anxiety Scale
6. Pretest
7. 100% KR
8. 33 1/3% KR
9. Regression Constant

TABLE VIII

TESTS OF INTERACTION BETWEEN ANXIETY
AND KNOWLEDGE OF RESULTS
(N = 95)

| | Hypothesis | $R_1^2$ | $R_2^2$ | df/Num. | df/Den. | F | Prob. |
|---|---|---|---|---|---|---|---|
| 2A. | Sound Immediate | .583 | .571 | 1 | 85 | 2.447 | .121 |
| | Sound Retention | .451 | .451 | 1 | 85 | .011 | .916 |
| 2B. | Light Immediate | .659 | .643 | 1 | 85 | 4.072 | .046* |
| | Light Retention | .651 | .649 | 1 | 85 | .229 | .633 |

$R_1^2$ = The multiple correlation coefficient associated with the full model

$R_2^2$ = The multiple correlation coefficient associated with the restricted model

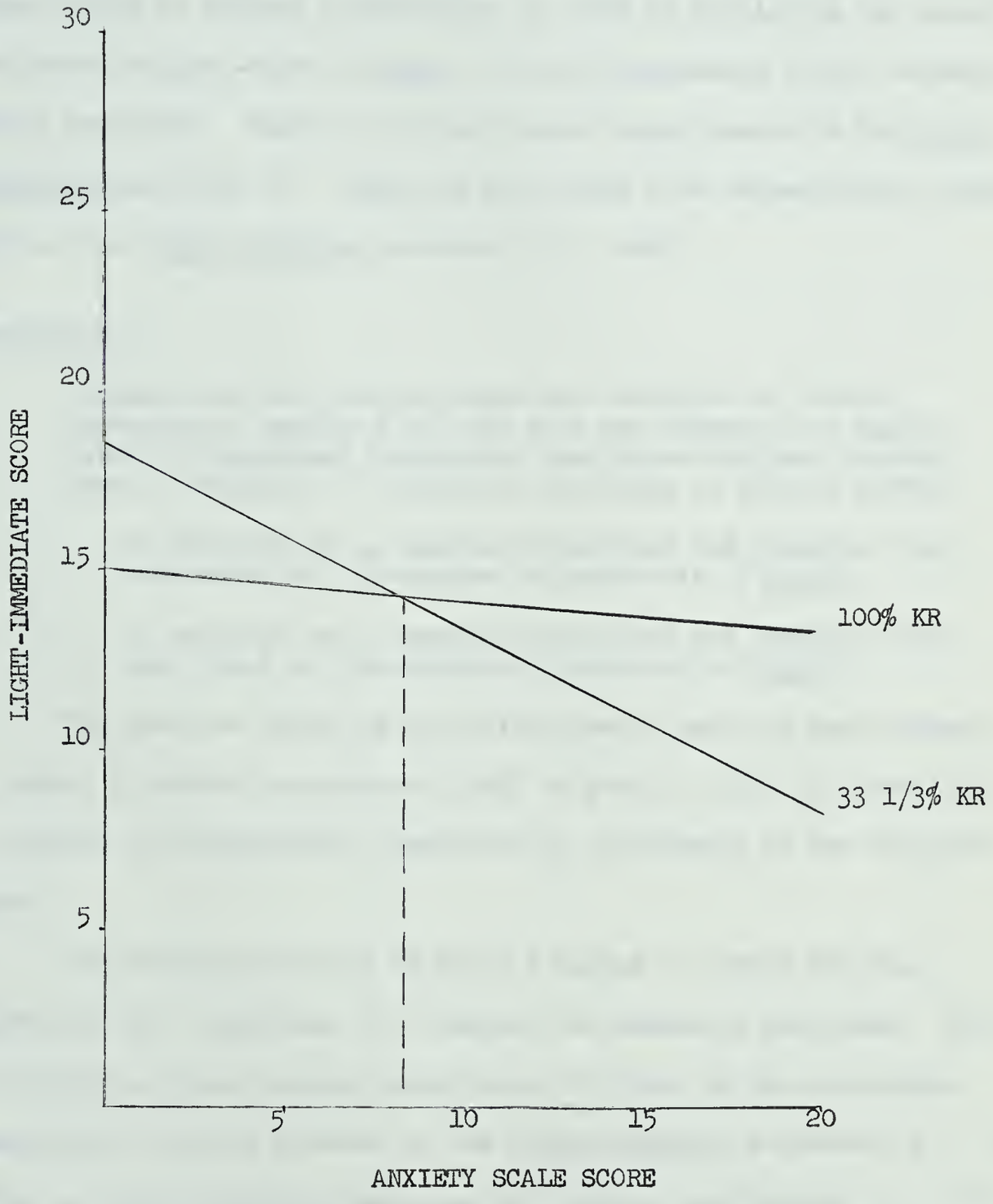


FIGURE 1

Interaction between anxiety and schedule of knowledge of results on Light Immediate

to Table IX reveals that Hypothesis 3A was not supported. The aggression index failed to achieve significance in terms of predicting the immediate and retention post-tests on Sound. However Hypothesis 3B was inconsistently supported. There is a trend towards significance on the Light-immediate post-test ($p = .099$) and this trend does become highly significant on the Light-retention post-test ($p < .0001$)

Hypothesis 4

> Students who have learned under the condition of partial knowledge of results (33 1/3%) will not achieve at a higher level in programmed instruction than those who have learned under a condition of continuous knowledge of results (100%):
>
> A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.
>
> B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

The question which the statistical model employed here attempts to answer is whether continuous (100%) or partial (33 1/3%) knowledge of results is significantly predictive of achievement on the criterion tests.

The findings reported in Table X failed to refute the null Hypothesis 4A. Hypothesis 4B, however, was generally supported. Table X indicates a trend towards significance in favor of the continuous knowledge of results schedule on the Light-immediate post-test ($p = .091$) while the Light-retention post-test did achieve significance ($p = .032$).

Non-hypothesized Results

Interaction of Agression and Schedule of Knowledge of Results.

Table XI clearly indicates that no interactional relationship was found

TABLE IX

MULTIPLE LINEAR REGRESSION TESTS OF
HYPOTHESES 3AAND 3B
(N = 95)

| | Hypothesis | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | $R^2$ | df | F | Prob. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Immediate | | | | | | | | | | | | | |
| 3A. | Sound (Full) | .231 | .043 | .067 | .015 | -.064 | .266 | .468 | .000 | -12.465 | .565 | | | |
| | Sound (Rest.) | .233 | .041 | .063 | | -.065 | .275 | .571 | .000 | -11.694 | .561 | 1/88 | .679 | .412 |
| | Retention | | | | | | | | | | | | | |
| | Sound (Full) | .199 | .137 | .094 | -.018 | -.069 | .176 | .775 | .000 | -24.236 | .432 | | | |
| | Sound (Rest.) | .197 | .138 | .098 | | -.070 | .166 | .650 | .000 | -24.965 | .428 | 1/88 | .617 | .434 |
| | Immediate | | | | | | | | | | | | | |
| 3B. | Light (Full) | .238 | .154 | .118 | -.037 | -.067 | .323 | 1.140 | .000 | -31.727 | .614 | | | |
| | Light (Rest.) | .231 | .155 | .127 | | -.071 | .327 | .888 | .000 | -33.094 | .602 | 1/88 | 2.777 | .099 |
| | Retention | | | | | | | | | | | | | |
| | Light (Full) | .287 | .118 | .080 | -.082 | -.072 | .394 | 1.484 | .000 | -24.769 | .645 | | | |
| | Light (Rest.) | .271 | .124 | .102 | | -.079 | .398 | .934 | .000 | -28.086 | .594 | 1/88 | 12.658 | .000 |

1. Science STEP test
2. Age
3. L-T Verbal IQ
4. Aggression Index
5. Anxiety Scale
6. Pretest
7. 100% KR
8. 33 1/3% KR
9. Regression Constant

to exist between aggression and knowledge of results on criterion tests for the Sound and Light programs.

Interaction of Anxiety and Aggression. As can be seen in Table XII an interaction was obtained between the personality variables of anxiety and aggression. Figure 2 indicates that aggression appears to make no difference to the low-anxious subjects (subjects one standard deviation below the mean on the anxiety measure). If an individual is very anxious then he would achieve best if he were aggressive. It should be noted that once again a significant F-value (.037) was found to exist for interaction on only one of the criterion tests (light-immediate) of the experimental Light unit.

Interaction of Anxiety, Aggression, and Schedule of Knowledge of Results. Table XIII reports the F-value for interaction according to the criterion tests used in this study. No three-way interactional relationship was found to exist amongst anxiety, aggression, and knowledge of results.

TABLE X

MULTIPLE LINEAR REGRESSION TESTS OF
HYPOTHESES 4A AND 4B
(N = 95)

| | Hypothesis | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | $R^2$ | df | F | Prob. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Immediate | | | | | | | | | | | | | |
| 4A. | Sound (Full) | .231 | .043 | .067 | .015 | -.064 | .266 | .468 | .000 | -12.465 | .565 | | | |
| | Sound (Rest.) | .236 | .045 | .065 | .018 | -.058 | .269 | | | -12.624 | .561 | 1/88 | .734 | .394 |
| | Retention | | | | | | | | | | | | | |
| | Sound (Full) | .199 | .137 | .094 | -.018 | -.069 | .176 | .775 | .000 | -24.23 | .432 | | | |
| | Sound (Rest.) | .207 | .143 | .091 | -.012 | -.058 | .181 | | | -24.870 | .424 | 1/88 | 1.280 | .261 |
| | Immediate | | | | | | | | | | | | | |
| 4B. | Light (Full) | .238 | .154 | .118 | -.037 | -.067 | .323 | 1.140 | .000 | -31.727 | .614 | | | |
| | Light (Rest.) | .250 | .160 | .113 | -.028 | -.052 | .326 | | | -32.304 | .601 | 1/88 | 2.924 | .091 |
| | Retention | | | | | | | | | | | | | |
| | Light (Full) | .287 | .118 | .080 | -.082 | -.072 | .394 | 1.484 | .000 | -24.769 | .645 | | | |
| | Light (Rest.) | .303 | .128 | .075 | -.071 | -.050 | .396 | | | -25.817 | .626 | 1/88 | 4.722 | .032 |

1. Science STEP test
2. Age
3. L-T Verbal IQ
4. Aggression Index
5. Anxiety Scale
6. Pretest
7. 100% KR
8. 33 1/33% KR
9. Regression Constant

TABLE XI

TESTS OF INTERACTION BETWEEN AGGRESSION
AND KNOWLEDGE OF RESULTS
(N = 95)

| | Criterion | $R_1^2$ | $R_2^2$ | df/Num. | df/Den. | F | Prob. |
|---|---|---|---|---|---|---|---|
| 1. a. | Sound Immediate | .583 | .582 | 1 | 85 | .015 | .900 |
| b. | Sound Retention | .451 | .433 | 1 | 85 | 2.715 | .103 |
| 2. a. | Light Immediate | .659 | .657 | 1 | 85 | .397 | .530 |
| b. | Light Retention | .651 | .647 | 1 | 85 | .858 | .356 |

$R_1^2$ = the multiple correlation coefficient associated with the full model.

$R_2^2$ = the multiple correlation coefficient associated with the restricted model.

TABLE XII

TESTS OF INTERACTION BETWEEN
ANXIETY AND AGGRESSION
(N = 95)

| | Criterion | $R_1^2$ | $R_2^2$ | df/Num. | df/Den. | F | Prob. |
|---|---|---|---|---|---|---|---|
| 1. a. | Sound Immediate | .583 | .577 | 1 | 85 | 1.150 | .286 |
| b. | Sound Retention | .451 | .451 | 1 | 85 | .044 | .834 |
| 2. a. | Light Immediate | .659 | .641 | 1 | 85 | 4.462 | .037 |
| b. | Light Retention | .651 | .649 | 1 | 85 | .446 | .506 |

$R_1^2$ = the multiple correlation coefficient associated with the full model.

$R_2^2$ = the multiple correlation coefficient associated with the restricted model.

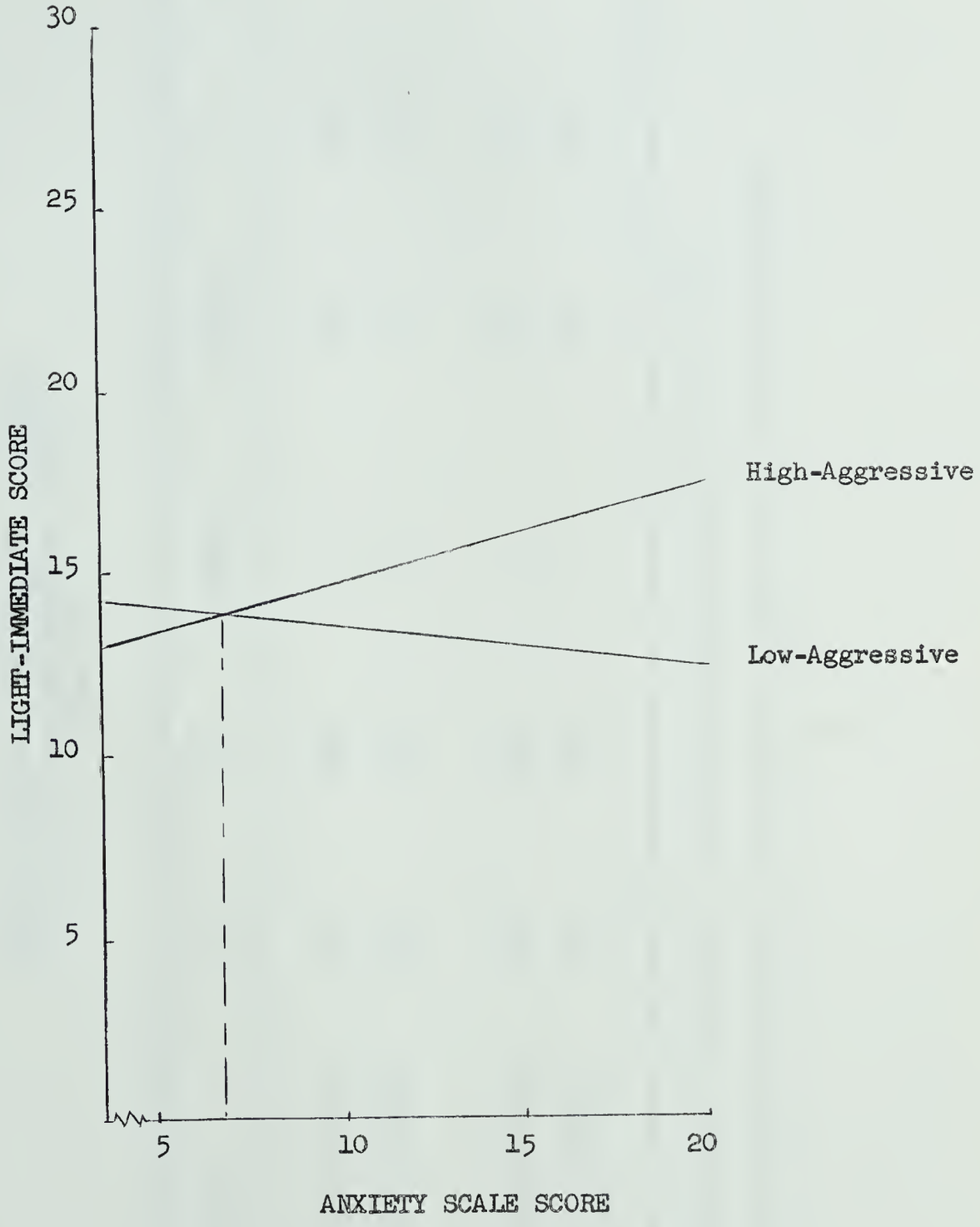


FIGURE 2

Interaction between anxiety and aggression on Light-Immediate

TABLE XIII

TESTS OF THREE-WAY INTERACTION: ANXIETY, AGGRESSION, AND KNOWLEDGE OF RESULTS (N = 95)

| | Criterion | $R_1^2$ | $R_2^2$ | df/Num. | df/Den. | F | Prob. |
|---|---|---|---|---|---|---|---|
| 1. | a. Sound Immediate | .583 | .582 | 1 | 84 | .062 | .803 |
| | b. Sound Retention | .451 | .451 | 1 | 84 | .036 | .849 |
| 2. | a. Light Immediate | .664 | .659 | 1 | 84 | 1.297 | .257 |
| | b. Light Retention | .659 | .651 | 1 | 84 | 2.093 | .152 |

$R_1^2$ = the multiple correlation coefficient associated with the full model.

$R_1^2$ = the multiple correlation coefficient associated with the restricted model.

# CHAPTER VI

## DISCUSSION AND IMPLICATIONS

The discussion, which follows, will be based largely upon the findings related to the hypotheses tested. Additional findings will be dealt with under the heading non-hypothesized results.

It is perhaps pertinent here to attempt to explain one consistent finding which has a definite bearing upon the interpretation of the results. The Sound experimental unit failed to reach significance on a single criterion test. It seems logical to expect that the Sound unit, being the first program the learners were exposed to, would be subject to a number of uncontrolled variables, one being the novelty effect. None of the subjects had had previous experience with programmed instruction. In addition, the Sound program has fewer frames and the reliabilities of the immediate and retention post-tests on Sound were lower than the Light tests (See Appendix D). Thus it appears that a more valid interpretation of the research findings would result from a discussion of those hypotheses that include the Light criterion tests. The conclusions, therefore, will deal primarily with the Light program.

One of the major purposes of this study was to determine the effect of anxiety upon achievement in programmed instruction. The review of the literature indicated that the high-anxious individual, under most conventional learning circumstances, achieved at a lower level than his less anxious counterpart. Furthermore, both previous research and the theoretical framework of this study had suggested that the high-anxious subject would learn best within a relatively structured teaching situation.

Programmed instruction was taken to be an exemplar of such a structured learning approach.

Hypothesis 1

> For those students identified as either high-anxious or low-anxious there will be no difference in achievement in programmed instruction:
>
> A. As measured on an immediate post-test and retention post-test based on a Sound programmed science unit.
>
> B. As measured on an immediate post-test and retention post-test based on a Light programmed science unit.

Hypotheses 1A and 1B were consistently supported in that tests of significance failed to reject the null hypotheses based on the criterion tests of both experimental units, Light and Sound. It appears that the apparent adverse effects of anxiety had little effect upon the achievement of subjects in a grade five science program. The fact that no significant differences were found between low and high-anxious groups on all four of the performance measures is in agreement with the hypotheses and previous research.

Hypothesis 2

> There will be an interaction between the structure of the teaching situation and anxiety, with the high-anxious students achieving better as the teaching condition becomes more structured.
>
> A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.
>
> B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

Hypothesis 2A was not supported by statistical analysis, whereas Hypothesis 2B was upheld on one of the Light criterion post-tests. The

high-anxious children performed better on the Light-immediate criterion post-test when learning under a condition of continuous knowledge of results. It appears that the very anxious subjects may be more alert to cues which serve to reinforce their present behavior and thus allay possible anxious feelings. The 100% reinforcement (knowledge of results) likely serves as a secondary reassuring function for the anxiety predisposed students. This interpretation, although speculative, is generally in agreement with what would be expected on the basis of previous research, for example Sarason et al (1960).

Hypothesis 3

> Those students who are identified as being high-aggressive will achieve at a lower level in programmed instruction than those identified as low-aggressive.
>
> A. On an immediate post-test and retention post-test based on a Sound programmed science unit.
>
> B. On an immediate post-test and retention post-test based on a Light programmed science unit.

The results of Hypothesis 3 were partially in support of what was hypothesized on the basis of both theory and research. Contrary to expectations, no significant difference was obtained between high and low-aggressive subjects on the Sound programmed unit. However, the findings of Hypothesis 3B indicated that subjects learning under the Light unit program experienced the negative effects of aggression. There was a tendency for high-aggressive subjects not to perform as well as less-aggressive subjects as measured on an immediate post-test. In addition, aggressive subjects were clearly disadvantaged in terms of retention of the programmed content of the Light unit ($p < .01$) over a two-week interval. Thus, the results of the study, involving the programmed

science content used here, clearly support the hypothesis that aggressive children are impeded in learning under a well-structured teaching situation such as programmed instruction. The findings of this study are also in agreement with the results reported by Lunzer (1960).

Hypothesis 4

> Students who have learned under the condition of partial knowledge of results (33 1/3%) will not achieve at a higher level in programmed instruction than those who have learned under a condition of continuous knowledge of results (100%):
>
> A. As measured on an immediate post-test and retention post-test based on a programmed science unit of Sound.
>
> B. As measured on an immediate post-test and retention post-test based on a programmed science unit of Light.

Hypothesis 4B failed to reject the null hypothesis for Light. It was shown that subjects learning under a schedule of continuous knowledge of results tended to do better on the Light-immediate post-test and significantly better on the Light-retention post-test. This finding in favor of continuous knowledge of results is contrary to the 'no difference' finding reported by Hough and Revsin (1963), Krumboltz and Weisman (1962a), and Glaser and Taber (1961). However, the populations sampled in the above studies consisted of college and senior high school subjects rather than elementary school students. The sample in the present study constituted fifth-grade students and Muir (1965) did find some evidence in favor of continuous knowledge of results for a fifth-grade population. Perhaps the most appropriate learning condition for an elementary school population, involving meaningful verbal material, is one which provides considerable reinforcement in terms of confirmation of the correctness of a response.

The Sound unit, Hypothesis 4A, failed to reveal any difference according to treatment (knowledge of results) (see page 65).

Non-hypothesized Results

There was, once again, a significant F-value obtained on one of the criterion tests of the programmed unit on Light. This interaction was between the personality variables of anxiety and aggression. The high-anxious, high-aggressive subjects did best on the science Light program, as measured by an immediate post-test, whereas the high-anxious, low-aggressive subjects did the poorest. The high-anxious, high aggressive child may be the individual concerned about his anxious state and one who attempts to reduce his anxiety in a rather direct, overt manner. Perhaps this kind of child is motivated by anxiety and is 'out-going' enough to channel his anxiety into some academic activity such as programmed instruction. Conversely, the high-anxious, low-aggressive child although likely anxious about school work is possibly unable to direct his energies efficiently towards the learning tasks at hand. This, then, might be the withdrawn, inattentive student who tends to daydream and whose attention span teachers find to be relatively short.

The overall analysis of this study tends to be generally supportive of theory with regard to the programmed Light unit. With the exception of Hypothesis 4, the hypothesized results were either partially or wholly confirmed. Therefore, the following tentative findings seem warranted:

Conclusions

1. Grade five students can learn science material by means of

programmed instruction. In addition, students at the upper elementary school levels appear to need considerable feedback, in terms of knowledge of the correctness of a response, at this particular stage of their learning. This was indicated by the better performance of those students who learned under a schedule of continuous knowledge of results.

2. Although high-anxious students perform as well in programmed instruction as low-anxious students, regardless of the schedule employed, they do slightly better under a condition of continuous reinforcement (knowledge of results).
3. High-aggressive students are impeded in their performance on linear programmed instruction as indicated by the Light criterion tests. A less well structured teaching method would likely be more appropriate for students with this kind of personality trait.
4. Finally, students who tend to be both low-aggressive and high-anxious may be very disadvantaged when learning via programmed instruction.

Limitations of the Study.

The above conclusions are considered only tentative in that the following factors might have confounded the results:

1. Practice effect--that is, the fact that identical forms of the criterion tests were employed for both pre and post-tests might account for the higher post-test scores.
2. Possible lack of construct validity of the scales.

3. Possible unrepresentativeness of the sample.

An attempt to overcome these limitations suggest obvious practical implications for further research in this area.

## Implications for Educational Research and Practice

> It appears that instructional methods make a difference for certain kinds of pupils and a search for the preferred method of teaching can succeed only when consideration is given to the personality of the learner (Sears and Hilgard; 1964, p. 205).

The quotation above aptly reminds educators of the need to constantly develop new methods in an effort to adapt the school situation to the individual learner. Indeed, if all students in our Western culture are to receive the fullest possible benefit from their schooling then some flexibility is a necessity. Programmed instruction represents one such relatively new method or tool for the classroom teacher. Today, nearly a decade after the pioneering work of Skinner and his associates, programmed instruction has shown to be an efficient learning aid in a large number of subject areas. However, too few researchers have attempted to determine whether or not achievement on programmed instruction is affected by the personality characteristics of the learner.

One implication of this study to future research is that two programmed science units, such as those used in this investigation, are insufficient in terms of establishing fairly conclusive results. It is possible that the first program students are exposed to may be influenced by a novelty or practice effect. In order to determine whether the findings of a second program are valid, a third experimental program similar in kind to the first and second should be included. The findings also suggest that continuous feedback (100 per cent knowledge of results) may

be a more appropriate learning condition than that provided under a condition of 33 1/3 per cent knowledge of results. However, it remains for further study to determine whether another schedule of reinforcement, perhaps one midway between 33 1/3 per cent and 100 per cent, would afford as equally a good learning condition as that provided by continuous feedback.

A control group using an adjunct program, which parallels more closely the classroom instructional situation than does a linear program, would help determine whether the crucial methods variable is feedback or structure. Since a learner may begin at various points in an adjunct program, less constraint is imposed upon a student than is the case when learning via a linear program. An adjunct program may not be as well sequenced as a linear program as it presents information in fairly large units or steps.

The findings cited here with regard to the influence of teaching methods upon anxiety and aggression, although tentative, do warrant further investigation. Definitive answers to the questions posed by this study are dependent upon replication using a similar population, differing programs and different grade levels. Finally, the findings also suggest a need to study other personality traits of learners and to determine the influence of such variables upon achievement in programmed learning. The likelihood that certain learning experiences may have negative as well as positive effects upon the achievement of the learner suggests an increased emphasis on individualization of instruction.

The principal justification for studies in the domain of education is that they may have practical implications for the educator. Programmed instruction, when properly used as a teacher-tool or adjunct, could be

utilized by the classroom teacher in an attempt to provide the best possible learning condition for the individual student.

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# APPENDIX A

# EXAMPLE OF THE SCIENCE TUTOR

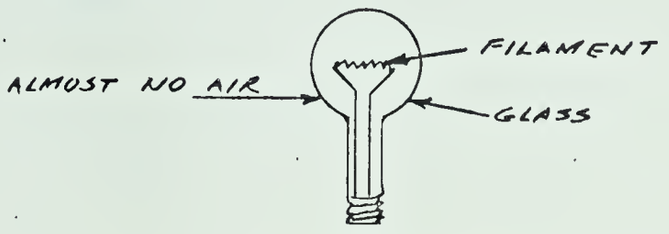
85. When electricity is passed through a filament it gives off _____.

85. a glow, light

86. The _____ is the wire in a light bulb that gives off light.

86. filament

87. After he had tried many materials, he found that carbon was the best material to use as a filament. Today the light bulbs we use have a small metal or wire filament.




88. The wire in an electric light bulb is called the f_____.

88. filament

89. Check your spelling! There are three syllables in the word fil.a.ment.

Is your spelling right in frames 86 and 88?

90. Practice your spelling. Fill in the blanks to spell filament.

_____ament, fil_____ment, fil_____

91. Now write the whole word three times.

_____, _____, _____

92. Edison used carbon as a f_____ in his light bulbs.

92. filament

93. If you break a light bulb, you will see a small wire inside the glass bulb called the _____. Danger: Do not break a light bulb! It will explode.

93. filament

94. Now recall something you know about fires. Can there be a fire when there is no air? _____

94. no

95. When something gets very hot in the presence of a_____, it will burn up. This is true of a

# APPENDIX B

## THE ANXIETY SCALE

# A RECORD ABOUT MYSELF

Instructions:

Read each of the statements below carefully, and decide whether it is true as applied to you, or false as applied to you. Answer every question.

Do not write on this booklet, place your answers on the separate answer sheet provided.

Work as rapidly as you can. There are no right or wrong answers.

1. I think a great many people pretend or exaggerate that they have had bad luck in order to get the sympathy and help of others.
2. I worry over not having enough money to buy things.
3. I do not like everyone I know.
4. I worry quite a bit over possible troubles.
5. Once in a while I put off until tomorrow what I ought to do today.
6. I am positive that I have done my best after I have taken a test.
7. When embarrassed I often become very warm and perspire which is very annoying.
8. I find it hard to make talk when I meet new people.
9. I often dream about things I don't like to tell other people.
10. My table manners are not quite as good at home as when I am out in company.
11. I am easily embarrassed.
12. I am aware of an uneasy feeling before I take a test.
13. At times I am full of energy.
14. My feelings are hurt easier than most people.
15. If I could get into a movie without paying and be sure I was not seen I would probably do it.
16. I often find myself worrying about something.
17. I have often met people who were supposed to be experts who were no better than I.
18. I find that I worry quite a bit when I am taking a test.
19. I wish I could be as happy as others.
20. I am happy most of the time.
21. Most of the time I am calm and not easily upset.

22. I do not read every sentence in my reading textbook.
23. I feel quite uneasy or upset about something or someone almost all the time.
24. I feel that my nervousness or worrying interferes with or lowers my performance on a test.
25. What others think of me does not bother me.
26. At times I have been worried beyond reason about something that really did not matter.
27. At times I feel like swearing.
28. I am more concerned about my behavior than most people.
29. I have periods in which I feel unusually cheerful without any special reason.
30. I feel very sure of myself when I know that I am going to write a test.
31. I am the kind of person who takes things hard.
32. I do not always tell the truth.
33. I am not at all sure of myself.
34. At times my thoughts have raced ahead faster than I could speak them.
35. Even when I feel I am well prepared for a test I usually feel anxious or nervous about writing it.

# APPENDIX C

# THE AGGRESSION INDEX

Each child was given a 'Guess Who' list together with a separate page containing a list of all the names of the children in the classroom. The names were arranged in two lists, one with the boys' names and the other with the girls' names. Each name had a corresponding number. The children were instructed to mark the number of those who fitted each question (excluding themselves).

GUESS WHO?

1. Who is a pest?
2. Who does not obey the teacher?
3. Who takes the teacher's things without permission?
4. Who is always getting into trouble?
5. Who tattles to the teacher?
6. Who is rude to the teacher?
7. Who starts a fight over nothing?
8. Who says mean things?
9. Who makes it hard for children to get things done?
10. Who pushes or shoves children?
11. Who does things that bother others?
12. Who forgets to return borrowed things?
13. Who often says "Give me that?"
14. Who makes marks on the desk?
15. Who takes other children's things without asking?
16. Who will always fight back if someone else hits them first?
17. Who gives dirty looks or sticks out their tongue at other children?
18. Who complains to the teacher when she tells them what to do?
19. Who grabs things from other children?
20. Who uses bad words when another child bothers them?
21. Who gets very, very mad at times?
22. Who makes up stories and lies to get other children into trouble?

# APPENDIX D

# ACHIEVEMENT TEST DATA

DESCRIPTIVE STATISTICS OF
CRITERION TESTS

| Test | No. Items | Mean | Standard Deviation | KR - 20 Reliability |
|---|---|---|---|---|
| 1. Sound Pretest | 25 | 8.18 | 2.56 | .2325 |
| 2. Sound Immediate | 25 | 12.14 | 3.68 | .6418 |
| 3. Sound Retention | 26 | 13.27 | 4.03 | .6892 |
| 4. Light Pretest | 30 | 10.50 | 3.72 | .5432 |
| 5. Light Immediate | 30 | 14.08 | 4.80 | .7444 |
| 6. Light Retention | 32 | 14.50 | 5.11 | .7552 |

# APPENDIX E

## THE CRITERION TESTS (RETENTION)

## SOUND

For each of the questions below select the best possible answer.

1. Scientists have shown that sound travels

   A. slower than light
   B. much slower than light
   C. about the same speed as light
   D. faster than light

2. Sound travels fastest when passing through

   A. a solid
   B. a liquid
   C. a vacuum
   D. a gas

3. Sound travels in the form of

   A. molecules
   B. electrons
   C. waves
   D. rays

4. Why are the walls of music rooms and radio studios often given special shapes or are covered with special materials?

   A. to make the sounds louder
   B. to avoid disturbing the neighbors
   C. to produce interesting echoes
   D. to control sound reflection

5. Which of the following <u>both</u> tend to increase the pitch of a vibrating string?

   A. an increase in length and a decrease in the tightness of the string
   B. an increase in the thickness, and a decrease in the length of the string
   C. a decrease in the thickness, and an increase in the tightness of the string
   D. a decrease in the tightness and a decrease in the thickness of the string

6. How are echoes produced?

   A. by reflection of sound waves from distant objects
   B. by sound waves which are driven back by the wind
   C. by sound waves being absorbed by hard surfaces
   D. by vibrations in distance objects

7. Sound will <u>not</u> travel in a

   A. tank of water
   B. metal pipe
   C. glass jar
   D. vacuum tank

8. When a tree falls in a forest, there will be a sound <u>only</u> if

   A. the tree hits the gound with a thud
   B. some animal is there to hear the thud
   C. the branches on the tree broke as it hit the ground
   D. sound waves were created when the tree struck the ground

9. The fact that a man has a low-pitched voice tell us that his vocal cords

   A. are short and thin
   B. are tightly stretched
   C. do not vibrate rapidly
   D. vibrate rapidly

10. If a friend of yours was to ring a bell about one hundred yards from you, where would you hear the sound most clearly?

   A. if you were on the moon
   B. if you were down a coal mine
   C. if you were in the middle of a large field
   D. if both the bell and your head were under water

11. The pitch produced by different keys on a piano is different mainly because of the differences in the

   A. length of time that the stringsvibrate
   B. the speed of vibration of the strings
   C. material against which the sound waves are reflected
   D. speed with which the hammers hit the strings

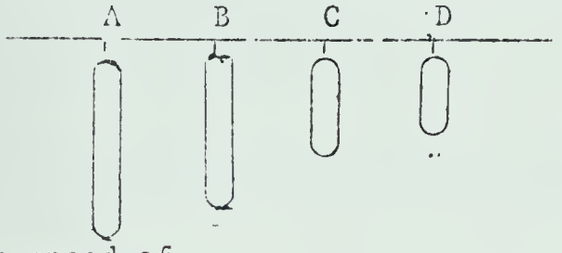
12. The ripples caused by a stone dropped into water and the sound from a ringing bell are similar because

   A. they both make a noise
   B. they can both be seen
   C. they are both wave motion
   D. they are both reflections

13. Sound will not travel through

   A. a solid
   B. a liquid
   C. a gas
   D. a vacuum

14. Some boys made a set of chimes by hanging four pieces of pipe of different lengths from a bar as shown in the picture below. Which of the four pipes made the lowest pitched sound when struck with a hammer?




A. pipe A
B. pipe B
C. pipe C
D. pipe D

15. Sound travels through air at a speed of

A. 1100 yards per second
B. 1100 feet per second
C. 1100 miles per minute
D. 1100 feet per minute

16. Sounds occur when

A. a bell is rung
B. two cars have an accident
C. lightning strikes the ground
D. an eardrum vibrates

17. If I wanted a sound to be heard a mile away, the fastest way of getting the sound there would be by

A. striking a railroad track a mile long
B. striking an iron bar in the air
C. ringing a bell
D. striking an iron bar in the water of a lake

18. Suppose you have four very tight strings. They are all thin. The string that would have the highest pitch would be

A. the string 25 inches long
B. the string 20 inches long
C. the string 15 inches long
D. the string 10 inches long

19. Which one of the following surfaces would produce the best echo?

A. soft, smooth
B. hard, rough
C. soft, rough
D. hard, smooth

20. If I hear the sound of a jet plane very high up and want to see where it is, I should

A. look behind where the sound seems to coming from
B. look ahead of where the sound seems to be coming from
C. look directly at where the sound seems to be coming from
D. look above where the sound seems to be coming from

21. The speed of sound is fastest in

A. air
B. iron
C. wood
D. water

22. Which one of the following musical instruments is able to make the lowest pitched sound?

A. piano
B. saxophone
C. trumpet
D. pipe organ

23. Which one of the following is <u>not</u> a form of vibration

A. the siren on a police car
B. the flashing red light on the police car
C. the squel of brakes when they stop the police car
D. the roar of the car's motor

24. Sound is possible only if some object is

A. heated
B. vibrated
C. stretched
D. compressed

25. Sound travels slowest when passing through

A. a solid
B. a liquid
C. a vacuum
D. a gas

26. Suppose you saw your friend chopping wood. You could see the axe hit the wood and then you could hear the sound later. If it took 2-1/2 seconds for the sound to reach you about how far away is your friend?

A. 1/2 mile
B. 1 mile
C. 1-1/2 miles
D. 2-1/2 miles

# A TEST IN ELEMENTARY SCIENCE

## LIGHT

For each of the questions below select the best possible answer.

1. The filaments of a modern light bulb are made of a material called

   A. carbon
   B. steel
   C. copper
   D. tungsten

2. Most electric light bulbs are filled with a gas called

   A. oxygen
   B. argon
   C. phosphorous
   D. neon

3. A fluorescent light gives off light because

   A. the filament glows
   B. the electricity is refracted
   C. gas particles bump into the sides of the tube
   D. the carbon coil gets very hot

4. What effect does the wearing of properly fitted glasses have on the eyes of those who have poor vision?

   A. glasses tend to weaken the eyes.
   B. glasses tend to improve vision and reduce strain on the eyes.
   C. glasses tend to remedy disease of the eyes and improve the strength of the eyes gradually.
   D. glasses correct certain faults in vision, but are likely to speed up the development of others.

5. Light travels in

   A. curved lines
   B. irregular paths
   C. straight lines
   D. circles

6. When sunlight strikes clean white snow, most of the light will be

   A. absorbed
   B. radiated
   C. refracted
   D. reflected

7. The bending of light waves is called

   A. refraction
   B. reflection
   C. rarefaction
   D. inversion

8. Most of the light we use today for lighting our homes is

   A. natural light
   B. fluorescent light
   C. artificial light
   D. carbon light

9. What is it that partly explains how light gets into a room whose windows are on the shady side of the house?

   A. the light curves and enters the room
   B. the light is reflected from the inside walls of the room
   C. the light is reflected in by objects outside the room
   D. the window acts like a camera lens and brings the light in

10. Light travels from the sun to the earth in about

   A. one year
   B. two hours
   C. five seconds
   D. eight minutes

11. Why are walls usually given a rough finish rather than a smooth one?

   A. wall paper sticks better to a rough wall.
   B. a rough wall absorbs less light.
   C. a rough wall spreads the light it reflects.
   D. a rough surface is a good reflector of light.

12. White light can be broken into rainbow colors by means of a

   A. mirror
   B. prism
   C. light meter
   D. reflector

13. Which one of the following shines by reflected light?

   A. a star
   B. the moon
   C. the sun
   D. a falling star

14. Which one of the following cannot be used to refract light?

   A. a convex lens
   B. a concave lens
   C. a prism
   D. a mirror

15. A bright blue coat contains a dye which absorbs all the following colors except

A. red
B. orange
C. green
D. blue

16. When a ray of sunlight goes through glass and changes its direction, the color of the ray which bends most is?

A. blue
B. violet
C. orange
D. red

17. We are able to see a red sweater because

A. the red light rays are absorbed by the sweater
B. all other colors except red are reflected by the sweater
C. the red light rays are not absorbed by the sweater
D. all colors are reflected by the sweater

18. The largest source of light known to mankind is

A. the sun
B. the stars
C. an atomic explosion
D. the moon

19. The first models of the electric light bulb were unsuccessful mainly because

A. the filaments would not work properly because of air in the bulb
B. the glass bulbs broke too easily when the air was removed
C. there was not a large enough supply of electricity available
D. the proper material for the filament could not be found

20. Which of the following does not have a convex lens?

A. the human eye
B. a magnifying glass
C. a searchlight
D. a telescope

21. Which one of the following does not refract light?

A. water
B. a lens
C. a mirror
D. a prism

22. White light is made up of

A. three colors
B. one color
C. no colors
D. seven colors

23. Rainbows are caused by raindrops acting as though they were

A. lenses
B. magnets
C. prisms
D. mirrors

24. A surface that absorbs all the wave lengths in the light which strikes it is

A. white
B. black
C. gray
D. colorless

25. Which of the following statements is true about the color of ordinary sunlight?

A. it is yellow in color
B. it is orange in color
C. it has no color
D. it contains all colors

26. Why is the flash of a distance explosion seen before the sound of the explosion is heard?

A. the sound has farther to travel than the light
B. air absorbs sound and reflects light
C. light waves travel faster than sound waves
D. the eye is more sensitive than the ear

27. A clear pane of glass does not cause a shadow when light shines through it because

A. light is reflected as it strikes the glass
B. the speed of light is less in glass than it is in air
C. light travels in straight lines
D. most of the light passes through the glass

28. On a warm, sunny summer day the surface of a dry concrete highway may appear to be wet in the distance. What causes this appearance?

A. there is considerable moisture in the air even on hot summer days
B. the bending of light rays by hot air near the highway produces the same effect as reflection from a surface of water
C. light rays that strike the concrete at a small angle are almost completely reflected
D. little particles vibrating in the concrete give the appearance of water ripples

29. What does a light year measure?

A. the distance between two bodies in space
B. the time it would take a rocket to travel to Mars or another planet
C. the brightness of light during daytime hours
D. the amount of light that the earth receives from the sun in one year

30. When observed from the bank, a post sticking up out of a clear stream appears to be bent. Why is this so?

A. light travels faster in water than in air
B. light is reflected when it strikes the water
C. light is absorbed by the water before it reaches the bottom of the stream
D. light is refracted as it passes from air to water

31. Rough surfaces reflect light

A. at right angles
B. curved lines
C. one direction only
D. many directions at once

32. A concave lens is used to

A. spread light waves apart
B. break up white light into several colors
C. bring light waves close together
D. shorten the length of the light waves

# APPENDIX F

## RAW DATA

KEY FOR RAW DATA

| Variable | Description |
|---|---|
| 1. | Identification of subject |
| 2. | Science STEP Test (4A) |
| 3. | Age in months |
| 4. | Lorge-Thorndike (3A) Verbal IQ |
| 5. | Lorge-Thorndike (3A) Non-verbal IQ |
| 6. | Aggression Index (1st administration) |
| 7. | Aggression Index (2nd administration) |
| 8. | Anxiety Scale (1st administration) |
| 9. | Anxiety Scale (2nd administration) |
| 10. | Socio-economic Status (Blishen) |
| 11. | Treatment: I = 100% KR 0 = 33 1/3% KR |
| 12. | Sex: I = male 0 = female |
| 13. | Sound Pretest |
| 14. | Light Pretest |
| 15. | Sound Immediate Post-test |
| 16. | Light Immediate Post-test |
| 17. | Sound Retention Post-test |
| 18. | Light Retention Post-test |

RAW DATA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01 | 19 | 135 | 93 | 101 | 4 | 18 | 10 | 6 | 47.2 | 0 | 0 | 4 | 10 | 7 | 8 | 11 | 9 |
| 02 | 50 | 124 | 131 | 119 | 4 | 13 | 16 | 16 | 47.0 | 1 | 0 | 7 | 16 | 17 | 20 | 18 | 26 |
| 03 | 37 | 125 | 112 | 115 | 3 | 4 | 18 | 15 | 52.8 | 1 | 0 | 12 | 6 | 12 | 14 | 12 | 14 |
| 04 | 42 | 130 | 112 | 95 | 14 | 17 | 16 | 14 | 47.2 | 0 | 0 | 10 | 10 | 9 | 9 | 13 | 15 |
| 05 | 39 | 136 | 101 | 105 | 4 | 17 | 11 | 12 | 50.2 | 1 | 0 | 10 | 10 | 12 | 16 | 16 | 22 |
| 06 | 46 | 130 | 118 | 118 | 10 | 11 | 11 | 12 | 43.2 | 1 | 0 | 12 | 12 | 14 | 16 | 13 | 18 |
| 07 | 55 | 131 | 123 | 126 | 4 | 7 | 6 | 8 | 47.2 | 1 | 0 | 9 | 15 | 14 | 21 | 14 | 25 |
| 08 | 47 | 125 | 145 | 131 | 10 | 15 | 11 | 8 | 47.2 | 0 | 0 | 6 | 14 | 14 | 14 | 10 | 16 |
| 09 | 51 | 126 | 117 | 129 | 13 | 21 | 14 | 12 | 54.2 | 0 | 0 | 7 | 15 | 20 | 17 | 17 | 16 |
| 10 | 38 | 138 | 108 | 101 | 4 | 22 | 7 | 6 | 51.6 | 1 | 0 | 7 | 14 | 11 | 15 | 18 | 13 |
| 11 | 41 | 129 | 118 | 108 | 8 | 12 | 13 | 12 | 52.8 | 0 | 0 | 6 | 14 | 10 | 15 | 14 | 16 |
| 12 | 49 | 129 | 130 | 115 | 16 | 32 | 10 | 15 | 47.2 | 1 | 0 | 10 | 16 | 16 | 25 | 17 | 24 |
| 13 | 50 | 120 | 135 | 111 | 1 | 1 | 12 | 9 | 43.6 | 0 | 0 | 10 | 8 | 11 | 18 | 12 | 20 |
| 14 | 37 | 120 | 101 | 105 | 9 | 11 | 12 | 10 | 43.2 | 0 | 0 | 10 | 9 | 9 | 10 | 7 | 8 |
| 15 | 49 | 131 | 113 | 119 | 7 | 2 | 14 | 16 | 47.2 | 1 | 0 | 7 | 9 | 14 | 19 | 16 | 23 |
| 16 | 37 | 132 | 112 | 111 | 10 | 13 | 15 | 14 | 40.8 | 0 | 0 | 4 | 12 | 8 | 13 | 9 | 13 |

RAW DATA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 36 | 129 | 109 | 95 | 10 | 11 | 11 | 12 | 63.5 | 1 | 0 | 13 | 7 | 14 | 11 | 15 | 10 |
| 18 | 45 | 125 | 120 | 127 | 11 | 4 | 12 | 12 | 61.8 | 1 | 1 | 9 | 15 | 12 | 17 | 14 | 17 |
| 19 | 34 | 132 | 99 | 82 | 38 | 25 | 14 | 9 | 47.2 | 0 | 1 | 10 | 7 | 7 | 6 | 7 | 5 |
| 20 | 45 | 126 | 127 | 127 | 9 | 7 | 18 | 17 | 43.2 | 0 | 1 | 12 | 20 | 17 | 20 | 18 | 19 |
| 21 | 37 | 136 | 110 | 104 | 8 | 6 | 6 | 8 | 47.6 | 1 | 1 | 10 | 8 | 8 | 11 | 12 | 14 |
| 22 | 36 | 123 | 109 | 103 | 58 | 41 | 10 | 7 | 43.6 | 0 | 1 | 8 | 3 | 7 | 6 | 3 | 6 |
| 23 | 36 | 134 | 95 | 98 | 1 | 3 | 11 | 11 | 47.2 | 0 | 1 | 5 | 7 | 7 | 7 | 10 | 14 |
| 24 | 34 | 130 | 103 | 90 | 15 | 4 | 12 | 11 | 47.0 | 0 | 1 | 7 | 3 | 10 | 5 | 13 | 6 |
| 25 | 47 | 134 | 94 | 102 | 73 | 42 | 10 | 12 | 47.3 | 1 | 1 | 6 | 10 | 14 | 12 | 14 | 19 |
| 26 | 47 | 124 | 119 | 128 | 2 | 5 | 14 | 12 | 45.2 | 1 | 1 | 6 | 12 | 14 | 15 | 16 | 21 |
| 27 | 47 | 132 | 107 | 115 | 25 | 23 | 3 | 7 | 47.2 | 1 | 1 | 13 | 18 | 18 | 19 | 18 | 15 |
| 28 | 52 | 132 | 127 | 125 | 43 | 22 | 14 | 14 | 57.0 | 0 | 1 | 14 | 20 | 19 | 23 | 15 | 22 |
| 29 | 35 | 130 | 121 | 109 | 11 | 13 | 9 | 10 | 57.7 | 1 | 1 | 8 | 13 | 12 | 13 | 14 | 16 |
| 30 | 51 | 125 | 135 | 131 | 10 | 9 | 12 | 13 | 47.2 | 0 | 1 | 13 | 17 | 17 | 24 | 17 | 23 |
| 31 | 49 | 135 | 117 | 115 | 12 | 12 | 14 | 15 | 47.2 | 1 | 1 | 6 | 13 | 15 | 18 | 19 | 19 |
| 32 | 38 | 132 | 103 | 90 | 134 | 70 | 17 | 17 | 63.5 | 1 | 1 | 8 | 10 | 16 | 14 | 14 | 6 |
| 33 | 37 | 127 | 110 | 107 | 11 | 16 | 9 | 17 | 44.4 | 0 | 0 | 6 | 7 | 10 | 13 | 9 | 14 |

RAW DATA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 34 | 46 | 139 | 112 | 104 | 6 | 16 | 15 | 12 | 48.0 | 0 | 0 | 6 | 10 | 14 | 12 | 15 | 14 |
| 35 | 36 | 138 | 102 | 105 | 4 | 3 | 12 | 10 | 47.1 | 0 | 0 | 7 | 10 | 7 | 14 | 8 | 16 |
| 36 | 53 | 133 | 150 | 128 | 1 | 1 | 13 | 10 | 60.6 | 0 | 0 | 14 | 14 | 16 | 22 | 20 | 22 |
| 37 | 36 | 128 | 107 | 103 | 0 | 1 | 11 | 13 | 40.8 | 0 | 0 | 8 | 15 | 14 | 6 | 5 | 12 |
| 38 | 41 | 133 | 95 | 99 | 11 | 17 | 15 | 14 | 44.4 | 1 | 0 | 5 | 6 | 12 | 18 | 12 | 12 |
| 39 | 52 | 127 | 129 | 124 | 0 | 0 | 3 | 1 | 63.8 | 1 | 0 | 9 | 10 | 18 | 19 | 19 | 24 |
| 40 | 46 | 134 | 106 | 103 | 39 | 58 | 12 | 11 | 47.0 | 1 | 0 | 11 | 9 | 15 | 17 | 10 | 12 |
| 41 | 39 | 134 | 111 | 114 | 11 | 19 | 16 | 20 | 47.2 | 1 | 0 | 9 | 8 | 9 | 12 | 12 | 10 |
| 42 | 43 | 129 | 121 | 128 | 2 | 8 | 11 | 8 | 52.8 | 0 | 0 | 7 | 4 | 13 | 20 | 15 | 16 |
| 43 | 44 | 133 | 111 | 112 | 5 | 23 | 18 | 19 | 43.6 | 1 | 0 | 5 | 12 | 8 | 16 | 9 | 14 |
| 44 | 36 | 136 | 109 | 100 | 13 | 25 | 9 | 14 | 51.6 | 1 | 0 | 7 | 7 | 13 | 12 | 14 | 11 |
| 45 | 33 | 128 | 101 | 114 | 19 | 14 | 17 | 15 | 47.2 | 0 | 0 | 3 | 9 | 7 | 10 | 9 | 12 |
| 46 | 52 | 126 | 159 | 141 | 6 | 5 | 12 | 7 | 64.0 | 1 | 0 | 7 | 17 | 17 | 23 | 18 | 20 |
| 47 | 50 | 134 | 116 | 103 | 0 | 2 | 13 | 15 | 61.8 | 0 | 0 | 12 | 13 | 17 | 13 | 19 | 14 |
| 48 | 39 | 129 | 111 | 116 | 3 | 4 | 9 | 11 | 47.2 | 1 | 0 | 11 | 6 | 10 | 13 | 12 | 12 |
| 49 | 27 | 130 | 115 | 106 | 2 | 3 | 9 | 10 | 60.1 | 0 | 0 | 7 | 11 | 9 | 12 | 10 | 8 |
| 50 | 30 | 129 | 101 | 93 | 3 | 3 | 17 | 17 | 44.4 | 0 | 0 | 7 | 16 | 11 | 9 | 12 | 9 |
| 51 | 40 | 130 | 115 | 98 | 3 | 3 | 15 | 18 | 63.5 | 1 | 0 | 11 | 6 | 13 | 10 | 13 | 16 |
| 52 | 45 | 127 | 100 | 112 | 2 | 8 | 14 | 10 | 47.8 | 0 | 0 | 6 | 10 | 10 | 11 | 10 | 14 |

RAW DATA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 53 | 44 | 130 | 97 | 95 | 3 | 6 | 14 | 11 | 45.0 | 0 | 1 | 5 | 14 | 5 | 15 | 9 | 15 |
| 54 | 47 | 146 | 106 | 111 | 4 | 1 | 12 | 9 | 57.0 | 1 | 1 | 10 | 15 | 13 | 17 | 9 | 22 |
| 55 | 26 | 131 | 103 | 92 | 41 | 15 | 17 | 17 | 40.8 | 1 | 1 | 7 | 12 | 7 | 8 | 10 | 10 |
| 56 | 42 | 124 | 110 | 119 | 24 | 7 | 11 | 12 | 45.2 | 0 | 1 | 11 | 10 | 14 | 11 | 20 | 10 |
| 57 | 40 | 126 | 107 | 105 | 9 | 2 | 12 | 12 | 49.8 | 0 | 1 | 9 | 8 | 10 | 9 | 8 | 10 |
| 58 | 45 | 128 | 118 | 101 | 13 | 9 | 7 | 11 | 43.6 | 0 | 1 | 8 | 10 | 16 | 9 | 19 | 17 |
| 59 | 49 | 134 | 119 | 114 | 24 | 5 | 19 | 14 | 43.6 | 1 | 1 | 11 | 15 | 14 | 17 | 22 | 16 |
| 60 | 20 | 152 | 83 | 87 | 16 | 9 | 12 | 10 | 43.6 | 1 | 1 | 5 | 11 | 6 | 11 | 7 | 8 |
| 61 | 48 | 131 | 123 | 125 | 3 | 1 | 10 | 9 | 41.6 | 0 | 1 | 6 | 15 | 17 | 20 | 21 | 22 |
| 62 | 50 | 133 | 119 | 102 | 38 | 6 | 10 | 11 | 48.0 | 0 | 1 | 7 | 11 | 16 | 21 | 22 | 16 |
| 63 | 35 | 141 | 92 | 81 | 145 | 54 | 12 | 9 | 47.2 | 1 | 1 | 7 | 11 | 6 | 12 | 13 | 17 |
| 64 | 36 | 131 | 99 | 93 | 8 | 2 | 10 | 11 | 61.8 | 0 | 1 | 10 | 8 | 6 | 12 | 13 | 10 |
| 65 | 36 | 139 | 90 | 92 | 27 | 66 | 8 | 11 | 49.8 | 1 | 0 | 9 | 10 | 7 | 5 | 11 | 7 |
| 66 | 41 | 131 | 127 | 123 | 3 | 7 | 15 | 13 | 61.8 | 0 | 0 | 8 | 7 | 14 | 20 | 14 | 18 |
| 67 | 38 | 132 | 103 | 106 | 6 | 13 | 7 | 8 | 41.6 | 1 | 0 | 6 | 9 | 13 | 14 | 11 | 15 |
| 68 | 36 | 132 | 106 | 100 | 2 | 0 | 5 | 4 | 43.2 | 0 | 0 | 8 | 13 | 13 | 20 | 14 | 16 |
| 69 | 46 | 129 | 111 | 97 | 0 | 1 | 7 | 5 | 49.2 | 1 | 0 | 4 | 12 | 14 | 18 | 14 | 22 |
| 70 | 51 | 133 | 121 | 108 | 15 | 15 | 12 | 9 | 40.8 | 0 | 0 | 10 | 14 | 16 | 21 | 17 | 19 |

RAW DATA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 71 | 33 | 126 | 106 | 104 | 1 | 8 | 11 | 9 | 44.4 | 0 | 0 | 3 | 8 | 4 | 6 | 5 | 7 |
| 72 | 42 | 130 | 112 | 92 | 2 | 4 | 5 | 6 | 43.2 | 0 | 0 | 8 | 7 | 11 | 16 | 15 | 14 |
| 73 | 27 | 127 | 97 | 102 | 1 | 4 | 9 | 2 | 47.2 | 1 | 0 | 5 | 9 | 11 | 11 | 11 | 10 |
| 74 | 43 | 127 | 115 | 128 | 1 | 6 | 12 | 12 | 44.1 | 1 | 0 | 7 | 10 | 12 | 13 | 14 | 12 |
| 75 | 44 | 128 | 119 | 108 | 1 | 3 | 14 | 6 | 43.0 | 0 | 0 | 8 | 12 | 11 | 14 | 9 | 10 |
| 76 | 41 | 152 | 99 | 91 | 1 | 4 | 6 | 6 | 45.6 | 0 | 0 | 6 | 4 | 10 | 13 | 15 | 9 |
| 77 | 39 | 130 | 109 | 112 | 5 | 7 | 10 | 13 | 43.2 | 1 | 0 | 6 | 8 | 13 | 13 | 13 | 13 |
| 78 | 20 | 152 | 80 | 94 | 1 | 3 | 2 | 4 | 45.9 | 0 | 0 | 4 | 8 | 9 | 14 | 13 | 14 |
| 79 | 42 | 132 | 103 | 120 | 22 | 33 | 12 | 12 | 51.3 | 1 | 0 | 6 | 4 | 7 | 10 | 10 | 6 |
| 80 | 30 | 127 | 102 | 100 | 0 | 4 | 14 | 15 | 43.6 | 1 | 0 | 8 | 5 | 6 | 9 | 7 | 9 |
| 81 | 42 | 127 | 117 | 133 | 40 | 47 | 6 | 8 | 54.2 | 1 | 1 | 7 | 11 | 14 | 12 | 15 | 12 |
| 82 | 49 | 141 | 98 | 101 | 10 | 11 | 14 | 12 | 46.0 | 0 | 1 | 12 | 7 | 17 | 13 | 12 | 12 |
| 83 | 48 | 129 | 138 | 122 | 47 | 36 | 5 | 4 | 47.2 | 0 | 1 | 10 | 15 | 17 | 20 | 18 | 17 |
| 84 | 42 | 133 | 106 | 121 | 49 | 42 | 12 | 8 | 43.2 | 1 | 1 | 11 | 7 | 20 | 9 | 17 | 10 |
| 85 | 26 | 138 | 87 | 88 | 49 | 22 | 8 | 10 | 47.2 | 0 | 1 | 5 | 7 | 7 | 7 | 5 | 10 |
| 86 | 47 | 136 | 101 | 81 | 32 | 12 | 11 | 14 | 47.2 | 1 | 1 | 12 | 6 | 12 | 14 | 12 | 13 |
| 87 | 38 | 183 | 94 | 105 | 10 | 3 | 13 | 10 | 43.6 | 0 | 1 | 7 | 8 | 10 | 10 | 11 | 9 |

RAW DATA

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 88 | 50 | 127 | 122 | 113 | 0 | 0 | 8 | 9 | 43.6 | 0 | 1 | 7 | 13 | 15 | 23 | 19 | 24 |
| 89 | 40 | 128 | 96 | 93 | 55 | 29 | 9 | 9 | 52.8 | 0 | 1 | 10 | 10 | 12 | 6 | 13 | 12 |
| 90 | 44 | 131 | 98 | 107 | 81 | 39 | 10 | 9 | 47.2 | 1 | 1 | 9 | 8 | 13 | 14 | 8 | 9 |
| 91 | 50 | 131 | 111 | 106 | 4 | 0 | 9 | 6 | 47.2 | 1 | 1 | 9 | 16 | 15 | 21 | 17 | 24 |
| 92 | 49 | 129 | 128 | 101 | 65 | 23 | 11 | 7 | 43.6 | 0 | 1 | 12 | 7 | 14 | 16 | 18 | 20 |
| 93 | 47 | 140 | 105 | 92 | 2 | 2 | 10 | 10 | 43.2 | 1 | 1 | 7 | 11 | 12 | 11 | 14 | 16 |
| 94 | 42 | 126 | 95 | 108 | 19 | 13 | 12 | 16 | 47.2 | 1 | 1 | 9 | 9 | 12 | 18 | 15 | 12 |
| 95 | 45 | 124 | 111 | 92 | 40 | 22 | 5 | 4 | 47.2 | 1 | 1 | 11 | 10 | 14 | 12 | 16 | 11 |